JUL 21 1927

Telephone Engineer

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STROWGER AUTOMATIC

Strowger Automatic's "Proving Ground"

THE telephone business is a constantly growing, constantly developing business. Every day new and better materials are being developed which must be adapted to existing equipment. Every day brings new service and traffic conditions for which new circuits and new combinations of apparatus must be designed.

To keep Strowger Automatic telephone equipment abreast of the times — ready to meet not only the needs of today, but also those of tomorrow — demands a keen appreciation of modern methods tempered with the conservative wisdom that comes from long experience.

The Research and Development Departments of Automatic Electric Inc. are composed of men who, for the most part, have devoted their lives to the development of Strowger equipment, to the end that it may meet the needs of today and tomorrow better and more economically.

Automatic Electric Inc.

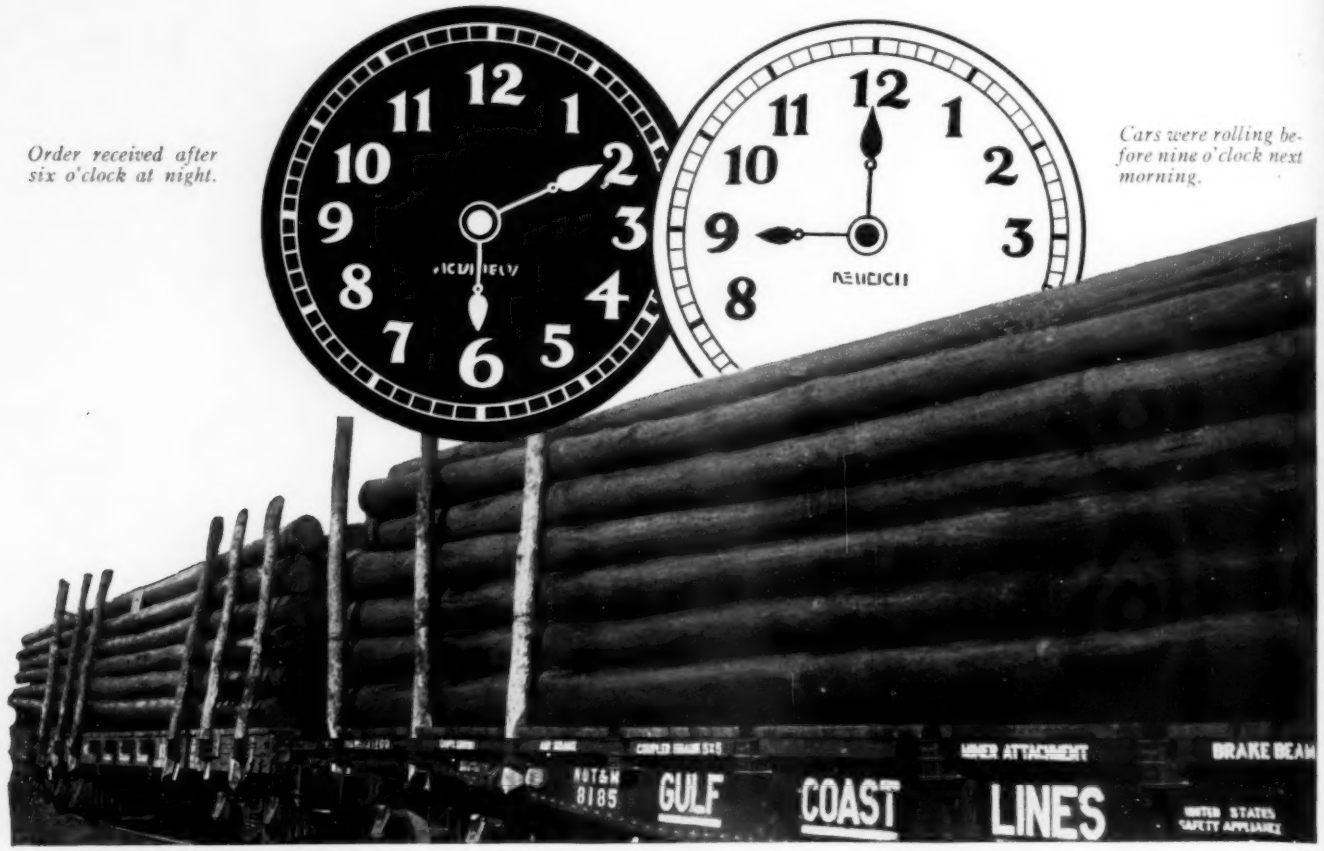
Factory and General Offices: 1033 West Van Buren St.
Chicago, U. S. A.

TELEPHONE EQUIPMENT

JULY, 1927

Order received after six o'clock at night.

Cars were rolling before nine o'clock next morning.



15 Hours After
The Order was Received

WHEN a cyclone ripped through Kansas and the Middle West, in the early days of May, destroying many untreated poles which had become weakened through decay, a wire was received at our Orange Plant at 6:10 p. m., May 9th, from the Union Electric Company of Abilene, Kansas, asking for immediate shipment of three cars of "Black Beauty" Poles to the United Power & Light Corporation, at Hutchinson, Kansas.

During the night three cars were loaded from our large yard stock of poles treated to standard specifications; and at 8:25 a. m. the following morning we wired them the car numbers and routing; and at 9:00 a. m. the cars left our plant, en route over the Missouri Pacific System—less than 15 hours after the order came in.

When you need good poles quickly—remember you can get them by wiring

"Black Beauty" Poles

Texas Creosoting Company
Main Office and Plant:
Orange, Texas, U. S. A.
American Electric Company, Inc.
Distributors of "Black Beauty" Poles to the Independent Telephone Trade
State & 64th Chicago, Ill.

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Telephone Engineer

Volume 31 JULY, 1927 Number 7

Call for Operators' Co-operation in Larger Offices

A well informed chief-operator in one of the smaller toll centers, after attending a well-conducted operator's school, made a remark that is worthy of consideration by traffic engineers and managers in large cities. She said, "I have gone to many operators' schools and have learned much as to how our smaller offices may co-operate to improve toll service and expedite the handling of traffic. I wish some way might be provided that schools could be held for the larger offices in order that there might be still better co-operation."

Questioned as to just what she meant, she explained further, that many times offers of co-operation on the part of the smaller office on inward calls were rebuffed by the distant outward operators. Very many times the inward operator has information regarding the location, movements or habits of subscribers that would aid in establishing a connection and yet she hesitates to volunteer this information because she is not sure how it will be received by the distant operator.

Another point where improvement might be made is in directory and information service in larger centers. She met the objection that larger centers could not know as much about individuals as the smaller towns by citing some cases. She said, "We can work into C——— (naming a city of upwards of half a million) and with the barest possible information can invariably locate our party. If we have a call for X———, unless we have all of the information necessary, it is almost impossible to get the connection established." It all depends on the help we get at the distant point."

From these comments it would seem that there are cases where the responsibility of the outward operator in the single ticket method of operation has been stressed to the point where many outward operators do not expect or welcome help from the distant office and where inward operators and directory operators do little else than furnish telephone numbers and ring subscribers lines. Co-operation works both ways and it is a fact that much benefit has come from stressing the necessity of co-operation at meetings and conferences of operators from the smaller exchanges. It might be well for those in charge of larger offices to examine conditions to make sure that they are lagging behind.

Associations Have Peace Making Tasks Ahead

The Journal of Commerce (New York) is quoted in the daily press as saying "it is evident that the feeling among utility executives is not as cordial as was at first supposed. The holding companies, in their eagerness to acquire new properties, have reached a point where they tend to interfere with each other's operations and much bitterness results."

While this refers principally to electric, water and gas companies—financial writers have a habit of ignoring the telephone as a public utility—there is a strong possibility that it may have a bearing on the future of the telephone business. There have been cases where different groups have been in active competition in the purchase of certain properties and other cases where one group has purchased a unit in territory that another group regarded as being particularly its own.

It is inevitable that a certain amount of bitter feeling should result from such conditions and this feeling is likely to be reflected in matters calling for united action by the industry. Much of the success of association activities in the telephone business has come from the fact that the companies in the associations have had many common interests and very few conflicting interests. When interests begin to conflict, it is a question whether association activities will receive the whole-hearted support of all member companies and there is even the possibility that opposing groups will actively contest for control of some of the associations.

An association without unanimity in policy, or under factional control, will be greatly restricted in its activities and usefulness to the industry. It is to be hoped that whatever conflicts of interest do

arise from the present activity in regrouping the companies in the business does not reach a point where concerted action is impossible in matters affecting the welfare of the industry as a whole.

Accident Prevention for Smaller Companies

One of the problems of the smaller and medium sized telephone companies is the carrying out of an effective accident prevention program. Many managers of such companies recognize a responsibility in this matter and yet have not been able to find a way to get the results they desire. They do not have facilities for training employes in safety practices and in first aid work. They are not large enough to justify a full or part time supervisor of safety.

While many of these companies congratulate themselves that they have very few serious accidents, it is not at all improbable that the number of accidents per 1000 men per year is greater than with the larger companies. The fact that relatively few men are employed may give a false sense of security. One lost-time accident per year for a company employing 10 men is just as bad a record as 100 lost time accidents for a company employing a thousand men.

Actually there are a number of things that may be done by every company, even the smallest. A small first aid kit may be provided for every truck and vehicle operated by the company. Employees can be instructed about calling for doctors to render first aid and can be given some simple instructions for their own use. In particular, the prone pressure method of resuscitation may be taught.

Above all, the habit of avoiding the taking of unnecessary chances can be cultivated. Responsibility for this can be put up to the foreman and he will usually respond if he sees that the management is in earnest. While formal accident prevention work may be practicable, it is surprising how much effect work can be done if the entire organization is trained to keep thinking about doing things in a safe way.

Vacation Cure for the Boss Who Is "Too Busy"

Vacation time is here again and Mary Roe, the operator, is studying railway time tables and summer resort literature. John Doe, the wire chief, is tuning up the old flivver for the trip with the wife and kids out to old Aunt Mary's in the country. About the only ones who are not making some plans are Henry Wise, the manager, and Bill Strong, the lineman; Henry because he thinks the job could not run without him and Bill because he doesn't get any vacation anyway.

Our sympathies go out to Bill, although he probably has never developed the vacation habit and might find some difficulty in putting in his time with a whole week off and nothing to do. On the other hand we have little sympathy for the stick-on-the-job-night-and-day manager typified by Henry Wise. He never has time for a vacation or to attend a district telephone meeting, much less a state or national convention.

Such a manager owes it to himself, to his company and his employees to get away from the job even if only for a few days. It may be somewhat of a blow to his self esteem to find that things have gone along as well when he was away as when he was at home, but it will give him some insight into the ability of the faithful helpers that surround him to carry on even without his presence.

Putting Two Pests Out of the Picture

The manager of an exchange in a suburb of one of our largest cities catalogues two telephone pests with which we had not previously been acquainted. One is the city salesman who takes his own sweet time about answering when called by his P. B. X. operator or while the suburban business man calling to place an order waits and pays overtime on his messages. One of these pests recently passed the buck to the telephone company, claiming that the operators overtimed the calls. Some of these days both the pest and his customer will get a nicely typewritten statement showing the actual time intervals determined from monitoring the calls.

The other pest is the individual who refuses collect calls and later tells a disgruntled customer that he has never refused the call; that the operator must have got the wrong number. This pest even goes to the length of asking the telephone company to take up the matter with the customer in order to pacify him. In one case at least he got little satisfaction for the toll operator had been thoughtful enough to have the number verified, which information conveyed to the customer decided him to seek another house from which to make his purchases.

Electrical Safety Code Sets Telephone Standards

As indicated in our Book Review column, a new edition of Part 2 of the National Electrical Safety Code is now available. This portion of the code deals with the installation and maintenance of electrical supply and communication lines and is the basis of recognized practice in all cases involving conflicts which may occur in the construction and operation of the various classes of lines. It is a reference book that should be in the files of every telephone company and the bringing of telephone lines at the earliest possible time into accordance with the standards set forth is an objective which companies might well set for themselves.

Capacity, Its Nature and Value*

By F. J. DOMMERQUE
Fellow A. I. E. E.

70. Definitions

In a previous discussion *capacity* was defined as the quantity of electrification which will raise the potential of a conductor to unity when all surrounding bodies are kept at zero potential, which was mathematically expressed by the equation $C = \frac{Q}{V}$, C being the capacity, Q the electrification and V the potential. This equation expresses the fact that the charge which a conductor will acquire is directly proportional to its capacity.

Circuits of all kinds, and in fact all conductors and insulators, are capable of storing a certain amount of electrical energy; capacity means their ability thus to contain electrical energy.

The unit of capacity is the "farad." For practical purposes this unit is too large and the "microfarad," or millionth of a farad, is commonly used. In Europe they prefer the electrostatic unit of capacity, which is the centimeter, because it lends itself best to their calculations. The relation between the different units is: 1 farad $= 10^6$ microfarad $= 9 \times 10^{11}$ cm.

The insulating medium or substance surrounding a conductor, such as air, paper, rubber, cotton, silk, etc., was defined as the *dielectric*.

Two or more conductors or plates with insulation between them form a *condenser*. The lines of force, shown in Fig. 79, passing between the plates will be straight, starting from the positively charged surface and terminating in the opposite surface. Let R be the electric intensity between the plates; then, if d is the distance between the plates, the work done on unit charge of electricity as it passes from the plate where the potential is high to one where the potential is low, is $R \times d$, this by definition is equal to V, the difference of potential between the plates. Hence $V = Rd$.

If σ represents the surface density of the charge on the plate of high potential, $-\sigma$ will represent that on the plate of low potential, and by Coulomb's law $R = 4\pi\sigma$, hence $V = 4\pi\sigma d$ or $\sigma = \frac{V}{4\pi d}$; if the difference of potential V is equal to unity, σ is equal to $\frac{1}{4\pi d}$. The charge on an area A of one of the plates when the difference of potential is unity is thus $\frac{A}{4\pi d}$, which is the capacity of the area A. This capacity is represented by an area divided by a length, and is, therefore, a linear quantity. The nearer the plates are together, the greater the capacity.

Faraday found that the charge between the two plates forming a condenser having a constant difference of potential between them depended upon the nature of the dielectric between the plates. With air as a dielectric the charge or capacity

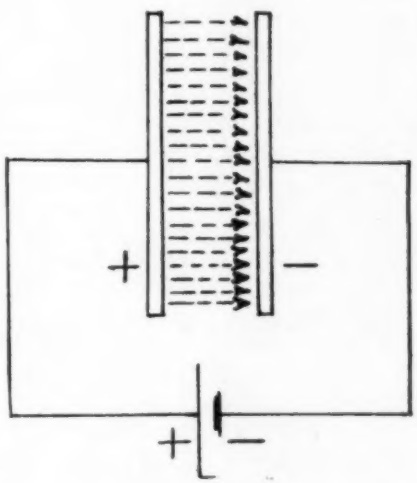

Fig. 79

is determined by the above formula. If any other substance is used as a dielectric the capacity is increased or decreased. This property of the dielectric is called its *specific inductive capacity* and is designated by "k," the *dielectric constant*. Hence the above formula for capacity should be written: Capacity $C = \frac{kA}{4\pi d}$.

Here the value of C is in electrostatic units. When centimeters are used in determining the area of the plates and the distance between them, the result obtained will be in microfarads when the formulas $C = \frac{1}{9 \times 10^{17}} \times \frac{kA}{4\pi d}$ is used.

The following table gives the values k of some substances and gases, the specific inductive capacity of air being taken as unity.

TABLE OF SPECIFIC INDUCTIVE CAPACITY

Flint glass, very light	k = 6.61 at 15° C.
Flint glass, light	6.72
Flint glass, dense	7.37
Flint glass, double extra dense	9.896
Mica	6.64
Beeswax	1.86 to 3.2
Resin	1.77 to 2.55
Porcelain	4.38
Varnished cambric insulation as used in cables	4 to 6
Sulphur	3.97
Ebonite	2.02 to 3.15
Guttapercha	2.462 to 4.2
Para rubber, pure	2.12
Rubber compounds, vulcanized	2.69 to 8
Paraffine, oil	1.92
Paraffine, solid	2.29
Castor oil	4.7
Cottonseed oil	3.1
Water distilled	76 to 81
Alcohol	26
Petroleum	2.07
Turpentine	2.23
Shellac	2.74 to 3.7
Manila paper	1.5
Paper, impregnated as used in cables	2.8 to 3.8
Fiber	5 to 8
Celluloid	7 to 10
Wood, maple, dry	3 to 4.5
Wood, oak, dry	3 to 6
Bakelite	5 to 7.5
Silk	4.6
Marble	9 to 12
Benzol	2.38
Hydrogen at atmospheric pressure	0.999674
Carbonic acid at atmospheric pressure	1.000356
Carbonic oxide at atmospheric pressure	1.0001
Olefiant gas at atmospheric pressure	1.000722

The dielectric has a resistance which is expressed in megohms. One megohm = 1 million ohm. The resistance of a condenser is expressed in megohm per microfarad. The insulation resistance of a cable is usually given in megohm per mile.

As the potential of a charged body is directly proportional to its charge, the charge Q is equal to the product of the difference of potential and the capacity, that is, $Q = VC$. If an e. m. f. is applied to the condenser and the difference of potential equals zero at the beginning and rises to V volts, then the *energy* stored in the condenser will be $W = \frac{QV}{2}$, that is, is equal to one-half the product of the charge of one of the plates and the difference of potential between the plates; since $Q = VC$, the energy may be expressed also as $W = \frac{CV^2}{2}$ or as $\frac{Q^2}{2C}$.

When the capacity is expressed in farads and the difference of potential in volts, the energy or work is expressed in joules.

71. The Capacity of Condensers

The capacity of a condenser of two parallel plates has been determined as

*16th article on *Telephone Mathematics and Physics.*

$C = \frac{kA}{4\pi d}$, where A is the area of each one of the plates, d the distance between the plates and k the dielectric constant. For practical calculation the area A is expressed in square inches and d in mils. As the above formula gives the value of C for A and d in C. G. S. units, that is in centimeters, this formula must be proportioned correspondingly when A and d are given in inches, by remembering that square inches multiplied by 6.4516 give square centimeters and mils multiplied by 0.00254 give centimeters. If there are a number of plates in a condenser as we find it in the variable condensers, and we designate the number of plates by n, then $C = (n-1)\frac{kA}{4\pi d}$ cm. or $= (n-1)\frac{1}{9\times 10^{17}} \times \frac{kA}{4\pi d}$ microfarad, when all dimensions are in centimeters, and $C = (n-1)\frac{1}{9\times 10^{17}} \times \frac{6.4516\,kA}{0.00254\times 4\pi d}$ when the dimensions of A are in square inches and of d in mils.

The form of condenser known as a Leyden jar, consisting of a glass jar the inside and outside surfaces of which are coated with tin-foil, has lately gained on interest on account of its usefulness in wireless telegraphy and telephony. The Leyden jar is, or has been employed to a large extent in small wireless sending stations; for larger plants, however, glass panes or plates have been used, coated with tin-foil and immersed in linseed oil or vaseline. Such condensers had to yield very powerful electrical oscillations and therefore required strong glass as a dielectric.

The capacity of a Leyden jar would be approximately $C = \frac{kA}{4\pi d}$, k varying from 6 to 10 for different specimens of glass, since this case is practically that of two parallel plates provided the thickness of the glass is very small compared with the radius of the jar.

Connecting together the insides of a number of jars and likewise all the outsides, that is, connecting the condensers *in parallel*, the capacities of the individual condensers are added, thus $C = C_1 + C_2 + C_3 + \ldots\ldots$, where C_1, C_2, C_3..... are the capacities of the individual condensers.

Connecting together the outside of the first of a number of jars or condensers and the inside of the second, the outside of the second and the inside of the third, and so on, that is, connecting the condensers *in cascade*, then the difference of potential V between the outside of the last jar and the inside of the first jar is $V = V_1 + V_2 + V_3 + \ldots\ldots$, where V_1, V_2, V_3..... designate the differences of potential between the inside and the outside of the individual jars. If Q is the charge of any jar, then $V_1 = \frac{Q}{C_1}$; $V_2 = \frac{Q}{C_2}$; $V_3 = \frac{Q}{C_3}$, and so on. Consequently $V = Q\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots\ldots\right)$ and $Q = \frac{V}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots\ldots}$; but since C is the capacity of the compound condenser, of which Q is the charge and V the difference of potential, $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots\ldots$, that is, the reciprocal of the capacity of the condenser made up by connecting in cascade a series of condensers, is equal to the sum of the reciprocals of the capacities of the condensers so connected up.

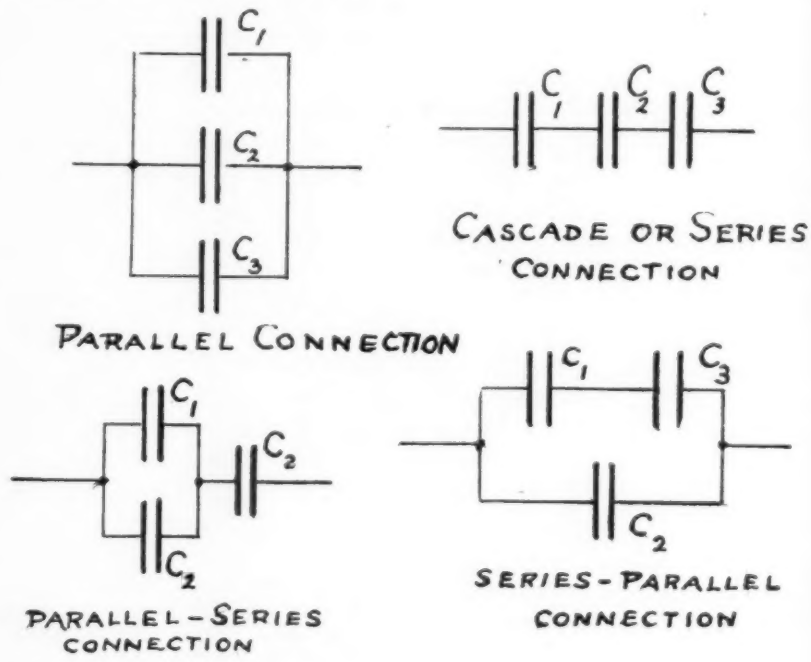

Fig. 80

In Fig. 80 is shown how three condensers are connected in parallel and in cascade or series. In addition there is shown two other kind of connections, namely, a *parallel-series* and a *series-parallel* connection. In the parallel-series connection the condenser C is joined in series with the two condensers C_1 and C_2, which are in parallel, and in the series-parallel connection C_1 and C_2 are connected in series and then placed in parallel to C_3. The capacity of the parallel-series combination is expressed by $\frac{1}{C} = \frac{1}{C_1 + C_2} + \frac{1}{C_3}$, and of the series-parallel combination as $C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}} + C_3$.

Attention may be called to the method of showing a condenser by two heavy drawn lines representing two condenser plates.

72. The Commercial Telephone Condenser

The capacities of condensers used in everyday telephony vary from ½ to 10 microfarads, this is for fixed condensers. The differences of potential are relatively small. Consequently large plate area is required and small distance between the plates. For variable condensers, which are used in wireless telephony, where the condensers have to withstand a very high voltage, the plates will be more widely separated and usually air or oil is used as the dielectric. The variable condenser mostly is built up of two sets of plates insulated from each other, one set being mounted so that it can be rotated with respect to the other.

A practical way to build a fixed condenser is to wind up into the form of a roll long strips of tin-foil, two strips of paper being interposed between each foil. After a condenser has been rolled to its proper size and connecting lugs have been inserted at the middle, so as to avoid any appreciable resistance being interposed into the condenser circuit, the sheets are cut, the entire roll is pressed out flat and inserted into a metal case. Instead of the sheets of tin-foil a paper coated with tin-foil, so called "tin-foiled paper," as invented by Mansbridge, is frequently used. These tin-foiled condensers have the advantage of easier manufacture, since only two strips of foiled paper, interleaved with two strips of plain paper are required; they are correspondingly cheaper, lighter and smaller than condensers of solid metal foil. They have

the further advantage of being practically proof against short circuits, and can be subjected to much higher voltages than is permissible with those made from metallic foil, any momentary short circuits produced by a disruptive discharge being instantly and automatically sealed, owing to the fact that the heat generated at the point of the short circuit is sufficient to cause the film of metal immediately surrounding the point of breakdown to be fused into minute globules. The segregation of these globules from each other and from the surrounding metallized surfaces effectually isolates the point of breakdown, and the defect is instantaneously sealed up. This circumstance should prove of value in the use of carbon block lighting arresters, where the mica separation might be replaced by such foiled paper and thereby the labor of renewals may be saved as a lightning discharge pinhole would thereby be sealed automatically.

If it is desired to obtain a capacity of 2 microfarad with 1¼ mil foiled paper and ½ mil interleaving paper, the area required for each electrode would be about 12½ square feet.

The condensers after being rolled are impregnated with paraffine. The insulation between the electrodes taken at 60° Fahrenheit with 400 volts after one minute's electrification usually lies between 1000 and 2000 megohm—microfarads.

A few words may be added as to the use of this kind of condensers in telephone circuits. There being no metallic connection between the plates of a condenser, a steady or continuous current can not pass through it. With an alternating current, however, the charges fluctuating up and down, or rather to and fro throughout the circuit, the plates of the condenser are alternatively charged and discharged in quick succession, thus the condenser will not block the propagation of alternating currents. It is therefore possible to talk over a line or through a circuit containing a condenser inserted to prevent the passage of direct current. If the rate of fluctuations, which means the frequency with which these fluctuations occur, is very high, as is the case with voice currents, the condenser will offer a much easier path than when the frequency is low, in which case the character of the current approaches more nearly to a steady or continuous current.

If on a line having a considerable number of magneto stations bridged across it, a receiver is left off the hook, the ringers at the other stations will not receive sufficient current to operate and it would be impossible for one subscriber to signal any other until the receiver is replaced. By placing condensers in the different stations in series with the receivers, this defect would be remedied without affecting the transmission noticeably, the talking current being of considerably higher frequency than the ringing current.

In a common battery subscriber's station the condenser answers a double purpose. In the first instance it prevents the direct current from flowing through the ringer, when the receiver is on the hook, and second it acts as a "booster" by producing an induced current in the primary winding of the induction coil in the same direction as the main current through it, effecting thereby an increase of probably 10 per cent in the distance over which a message could be transmitted without the condenser.

A condenser inserted in series with an operator's receiver will prevent the receiver from having its magnets weakened on the one hand, on the other hand from having its diaphragm pulled against the pole faces, continuous current being on the line all the time. The condenser also reduces the "click" in the operator's receiver when the listening key is operated.

A condenser across the primary winding of the operator's induction coil in a common battery system enables the operator to talk to a subscriber without the talking current produced by her transmitter traversing the battery and without being overheard by another party using the battery at the same time.

When a circuit containing a self inductance (which will be defined in our next article) is opened a spark is caused between the contacts of a switch. The insertion of a condenser at this place will absorb the energy of the magnetic field which is liberated by the opening of the circuit and thereby the energy of the spark and prevent any destructive effects upon the contact springs. The same holds true for relay contacts and the contacts of automatic switches.

73. Capacity of Telephone Lines.

Telephone wires carried on poles form a condenser; the insulators and crossarms have more or less effect upon the capacity of the wires. The earth itself, being a conductor, also acts as one plate of a condenser in the system. Other conductors in the immediate vicinity of a telephone circuit render the case still more involved. In a telephone cable paper is the dielectric, where in aerial lines air is the dielectric. Any single conductor in a cable may be regarded as one plate, the other plate being the adjacent wire of the pair or the lead sheath of the cable itself. The great length of the lines gives the wires a comparatively large surface and hence large capacity. One thousand feet of No. 8 copper wires suspended 12 inches apart, have a capacity of 0.0032 microfarad. A mile of No. 22 telephone cable has a capacity from 0.07 to 0.08 microfarad.

If the mutual effect of two parallel wires is considered, while the reaction of neighboring bodies, the earth included, is neglected (which in a majority of cases is possible without making a sensible mistake) the capacity can be determined by a formula developed by Oliver Heaviside in his paper "On the Electrostatic Capacity of Suspended Wires."

Two wires suspended parallel to each other at distance d, having a radius r, would have a capacity $C = \frac{1}{4 \log_e \frac{d}{r}}$ or

$C = \frac{0.4343}{4 \log \frac{d}{r}}$ per centimeter length of line.

The capacity is in electrostatic C. G. S. units. To transform same into microfarads, divide by 900,000. To transform into microfarad-miles multiply the electrostatic units by 0.19. To transform into microfarad-kilometers multiply by 0.1205. A pair of conductors in a cable of many pairs has a capacity

$$C = \frac{k}{36 \times \log_e \left[\frac{8}{10} \times \frac{2d}{r}\left(1 - \frac{3}{10}\frac{r}{2d}\right)\right]} \times 10^{-9}$$

farads, where $k = 1.6$ for papercable, r = radius of conductor, $2d$ = distance between centers of a pair.

When a wire is suspended at a height "h" above the ground and the earth used as a return circuit for the wire, the ground may be replaced by an imaginary wire situated at an interaxial distance from the real wire equal to 2 h (the imaginary wire is called the "image" of the real wire by Heaviside), in which case the capacity of the aerial wire with ground return would be $C = \frac{1}{2 \log_e \frac{2h}{r}}$ for one unit of circuit length, in electrostatic measure.

Heaviside also calculated the effect of adjacent wires and arrived at the following conclusion: A second wire increases the capacity about 11 per cent, and with three or more the increase is about 24 per cent, and a greater number will of course produce still further increase.

Probably the most important case of the effect of adjacent bodies is the consideration of the reaction of the earth on a complete metallic circuit. For this combination Heaviside shows that the capacity is given by the expression

*Oliver Heaviside; Electrical Papers, vol. 1, page 43.

$$C = \frac{2 \log_e \frac{2h}{r}}{2 \log_e \frac{2h^2}{r} - \left(2 \log_e \frac{\sqrt{d^2 + 4h^2}}{d}\right)^2} \text{ or}$$

$$C = \frac{0.4343 \left(2 \log \frac{2h}{r}\right)}{2 \log \frac{2h^2}{r} - \left(2 \log \frac{\sqrt{d^2 + 4h^2}}{d}\right)^2}.$$

As our space is limited we will give only one example, also from Heaviside, namely, for a wire suspended alone at a height of 3 meters above the ground and having a diameter of 4 millimeters. Heaviside gives the following solution: "Capacity $C = 0.0624$. To bring into electromagnetic measure this must be divided by $(28.8 \times 10^9)^2$; to bring the results into microfarads, multiply by 10^{15}; and lastly multiply by the number of centimeters in a mile to find the capacity in microfarads per mile. The result is 0.0121 microfarads per mile." Heaviside is very brief; we will, however, expend this example thus: IInserting $h = 3$ meters $= 300$ centimeters, and $d = 4$ millimeters $= 0.4$ centimeters into the formula $C = \frac{1}{2 \log_e \frac{4h}{d}}$, which is Heaviside's way of writing our formula $C = \frac{1}{2 \log_e \frac{2h}{r}}$, we have $C = \frac{1}{2 \log_e \frac{4 \times 300}{4}} = \frac{1}{2 \log_e 3000}$. But $\log_e 3000 = \frac{\log 3000}{0.4343}$, hence, as $\log 3000 = 3.47712$, we have $\log_e = \frac{3.47712}{0.4343} = 8$, whence $C = 0.0624$.

Heaviside gives as proportionality factor for the conversion into electromagnetic units the value 28.8×10^9. In table 2 of our section 30 in which we spoke of the C. G. S. electro-magnetic system we designated the ratio of the two systems by V^2 and said that "a capacity measured electrostatically equals a capacity measured electromagnetically multiplied by the square of a velocity," but we did not state what the velocity was. Here Heaviside tells us that it is 28.8×10^9.

We have not developed any of the preceding formulae, because it requires mathematics too difficult for the non-mathematician; it takes a mathematician of high grade at that to be able to follow Heaviside's mathematics.

74. Electrostatic Capacity Measurements

The most accurate and convenient method of measuring electrostatic capacity is to compare the unknown capacity to be estimated with that of a standard condenser. Fig. 81 shows the arrangement for the test. Supposing the capacity to be measured is that of a cable, the apparatus is so disposed that either the standard condenser or cable, by means of a key, may be charged from the same battery, and discharged through a galvanometer. Under these circumstances the relative capacities are proportional to the deflections produced on the scale of the galvanometer. These deflections must be multiplied by the proper factor in case the galvanometer is shunted to bring the readings within the limits of the scale.

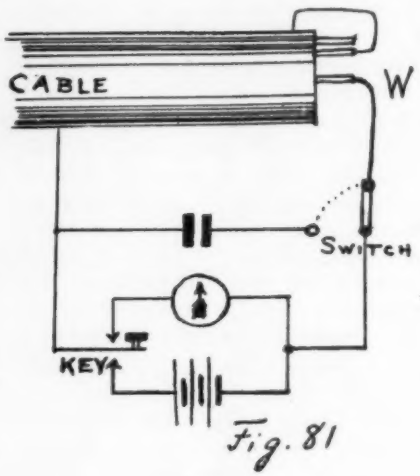

Fig. 81

If a ballistic galvanometer is employed, the scale readings can be used without correction. If an ordinary galvanometer is used, or one in which no provision is made for checking the motion of the needle, a correction for the errors thus introduced must be made. This correction may be obtained by observing the first swing of the needle to the right, giving, for example, a deflection d_1; then the second swing also to the right, giving the deflection d_2. The true deflection on the scale is obtained from the equation

$$d = d_1 + \frac{d_1 - d_2}{4}.$$

Should the deflections given by the discharge of the cable and that of the standard condenser be sensibly equal, no correction is needed.

To make the test press down the key and charge the cable for the specified length of time (in telephone practice about ten seconds); then release the key and note the deflection of the galvanometer. Disconnect wire W (Fig. 81) and determine in like manner as before the discharge deflection. Subtract the second deflection from the first and obtain the true deflection d. Now throw the switch so as to connect the condenser, which in this case should have a capacity nearly equal to that of the cable, and determine both the total discharge deflection and that due to the leading wires; subtract the latter from the former, which will give the true deflection d'. If C is the capacity of the cable to be measured and K the capacity of the condenser (in microfarads) then $C = \frac{K \times 5280d}{L d'}$ per mile, L being the length of the cable. If K cannot be made comparatively near the capacity of the cable, good results can be obtained by subdividing the battery for whichever has the largest capacity. For instance, if the condenser has three times the capacity of the cable, divide the battery into about three equal parts and take the discharge deflection of the condenser for each of the three; then for d' use the sum of the above, which represents the discharge deflection that would have been obtained had the full battery been used and were the galvanometer scale long enough to read the deflection. The full battery should then be used to obtain the discharge deflection of the cable. If the cable has the larger capacity the operation should be reversed.

To measure the capacity by the *testing set*, the connections of which are shown in Fig. 70, section 51, on the Wheatstone Bridge, the galvanometer is not used, but in its place a telephone receiver is connected to the galvanometer binding posts and the small single throw switch is placed to the side marked "out." The flexible battery cords are connected to the alternating current posts of the transformer and the flexible tips of the transformer are connected to one or more cells of battery as necessary. This will start the transformer in operation with a slight buzz and furnish an alternating current. The unknown capacity is connected to the line posts.

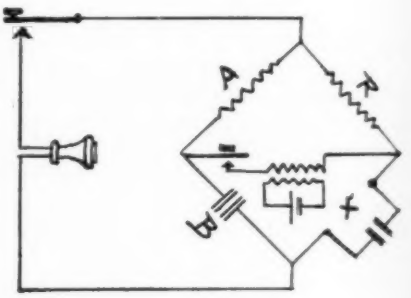

Fig. 82

Place arm B at ⅓ M.F. and switch in 1000 ohm coil on the A side of the bridge; place 1000 ohms in the rheostat. A sound will now be heard in the telephone receiver, which will be either increased or decreased by increasing or decreasing the rheostat resistance. When the noise in the receiver is reduced to a minimum by switching in more or less resistance, this value may be taken as representing the balancing point and the

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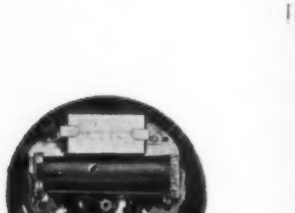

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In this instrument, the induction coil and condenser are mounted in the base. A two conductor cord connects the telephone to the bell box or line terminals thus permitting the use of the regular bell box already installed. In all other respects the Two Conductor Como-Fone is similar to our standard Como-Fone.

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unknown capacity is $C = \frac{1}{3} \times \frac{A}{R}$. It is, of course, evident that other values besides the 1000 ohm coil in the bridge arm A may be used. Fig. 82 gives a skeleton diagram of the testing set connections for capacity measurements.

Attention may be called to the difference between test "to ground" and test "for mutual capacity." In the test to ground one wire is tested against all the remaining wires grounded to the sheath, while in the test for mutual electro-static capacity one wire is measured against its mate, the remaining wires being grounded to the sheath, as indicated in Fig. 81. The capacity by the latter method of connections is about two-thirds the capacity by the former method of connections, and is preferable when writing specifications.

Some Thoughts on Switchboard Design

By RAY BLAIN

While we must admit that switchboards from a service standpoint are being improved constantly, we cannot say that the design of the cabinet or the arrangement of the equipment in it, in many cases has reached a point approaching near perfection. This is more especially true of the small, one or two position P. B. X. switchboards.

For example, take the case of a small switchboard which is to have the cables formed and connected to the line jacks by the installer. The line jack strips on each side come within an inch or so of the sides of the cabinet. If the cables cannot be formed and connected to the jacks before placing in the board by the installer, he will have a very difficult task and perhaps skin both elbows trying to perform this difficult feat in the small space provided. Aside from all of this there is not sufficient space for the cables to form and turn at the end of the jacks to a point where the first skinners break out of the form. In multiple swtchboards of three positions or more this space is provided by the installation of a small turning section but for some reason no space is considered necessary in one or two position cabinets.

I am a firm believer in having all line jacks in a small board hooked up in the factory and terminated on a pin terminal board either on the relay rack or hinged on just above it. With this arrangement it is not a difficult task for the less experienced installer to make a neat installation that will give service. If the line cables must be connected directly to the line jacks by the installer then a space of two or three inches should be provided on each end of the line jack strips. The space on the opposite side from where the cables are formed might be utilized to good advantage for the installation of a small cabinet to accommodate toll tickets, pencils, directories, etc.; a much neater arrangement than permitting them to accumulate on the key shelf and top of the switchboard.

The idea of having the relay rack mounted on hinges is a very good one, but it should swing in the clear or in other words to right angles with the back of the switchboard. It must swing free of all obstructions and be capable of being closed without jarring relays out of adjustment. The rack should be held firmly in place when closed by a large wing nut or other clamping device.

The cord supervisory signals used by some manufacturers are very difficult to see. The principal reason for this is that the lamp is hid behind a large hunk of colored glass resembling a cheap marble cut in half. Then to make matters even worse the glass is covered with a metal guard with holes punched in it resembling a collander. This arrangement I believe is carrying the idea of a dark key shelf a little too far. The supervisory signal should be bright enough that the operator can quickly associate it with the cord. A large supervisory pilot light mounted in the panel opposite the regular line pilot will be a help to the operator in answering recalls promptly.

Bakelite covered key shelves are very good as they stand the wear much better than the hardest of wood and always look neat without much attention. The answering cords should not be too close to the piling rail and I prefer them elevated about 5/8-in. above the calling cords as this makes them much more convenient for the operator and saves time in picking up cords.

The ringing tone that notifies the calling party that their number is being rung is a desirable feature on any switchboard.

Why the Relays?

I have never been able to understand why there are so many relays in some simple circuits. I do believe in eliminating relays if they perform some work and are necessary in a circuit. On a certain trunk circuit I eliminated half the relays and make the remaining perform the same functions as the total number by rearranging the spring assembly. The transmission of the circuit was also improved. Show the average engineer how to eliminate one relay and he will immediately find a good excuse to add two and will give you many reasons why they are necessary.

Some manufacturers I regret to say are still covering the cable forms with several coats of nice shiny shellac, which makes them resemble the varnished ducks and rats which I saw in the street markets in China last winter. While I understand that the varnish does act as a preservative, the shellac in most cases acts just the reverse. It has been proved that orange shellac contains moisture and that it is harmful to cotton insulated cables. If you must shellac then use a good grade of white shellac that you are positive does not contain moisture. I believe that a cable boiled out in beeswax is safe in the average location but as an extra precaution a quantity of rosin can be added if considered advisable.

When a skinner is shellaced it is perfectly rigid and all bending and vibration affects the wire where it is soldered to the terminal. For this reason there is always more open circuit trouble on a board where all of the forms are shellaced. When the forms are just boiled out in beeswax the skinners are flexible and will stand much more handling or vibration without trouble.

The key shelf should be provided with a holder to hold it firmly in an elevated position when it is necessary to make repairs on the under side. If this brace is not provided it is necessary to prop the key shelf in an elevated position with a long screw driver or some other makeshift which is both troublesome and difficult. Above all things place a good lock on the key shelf so that the operator can't use it as a hiding place for chewing gum or possibly cigarettes.

I don't expect that all manufacturers will agree with me in all of these ideas but I do think that most troublemen and installers will.

International T. & T. Has Great Year

New York City—A large increase in its holdings in foreign countries is disclosed in the annual report for 1926 of the International Telephone and Telegraph corporation. The largest transaction was the acquisition of a large interest in All America Cables through exchange of capital stock. On March 21, 1927, controlling interest in the Montevideo Tel. Co., Ltd., operating the telephone system in Montevideo, Uruguay, was purchased.

Consolidated net income of the International Corporation for 1926 amounted to $7,105,206.44 as compared with $4,668,228.46 for the year 1925. This was equivalent to $12.13 per share on the stock outstanding on Dec. 31, 1926.

Practical Suggestions for Plant Valuation

By CHARLES W. McKAY, M. E.

CHAPTER I

Foreword.

In the June TELEPHONE ENGINEER the writer discussed the subject of financing telephone companies in an article entitled "Common Sense and Telephone Finance." Several thoughts have prompted further comments on telephone financing.

In connection with the writer's practice as a Consulting Telephone Engineer, a number of propositions have come to his attention which have been meritorious—but, due to the fact that the properties involved were too small, the propositions in question had to be side-tracked for the time being. The cost of underwriting a loan or re-financing a telephone property, is necessarily large. In other words, it costs the banker, or financial underwriter, almost as much to handle a small loan as it does to negotiate a relatively large one.

The writer has been consulted on this question by a number of bankers and has always made the suggestion that some attempt be made to induce the applicant for the loan (when the property was a very small one) to get together with some of his telephone neighbors and present a sizable proposition. One of the chief objections to such procedure was the cost of appraising the property. Naturally, the banker must know the fair value of the property before he can consider the question of refinancing.

The thought came to the writer's mind that it might be possible to minimize the cost of appraisement by preparing a series of articles outlining the proper method of procedure and defining what portion of the work may be done by a company's own employes. Quite naturally, if a portion of the work of inventory and appraisement of the telephone property *can* be done by the company's own employes the cost of valuation will be materially reduced.

On the other hand, the Reader should remember that an operating telephone company cannot prepare a valuation, in its entirety, which will be acceptable to financial underwriters—or to state commissions, in such cases where the valuation is to be used for rate making purposes.

The reason for this will be obvious—if one is placing a value on his own property (even though he may be "as honest as the day is long") such a valuation is bound to be open to question, for the simple reason that one is apt to be prejudiced in regard to one's own possessions—or, others may consider that one so prejudiced.

In the case of telephone appraisal, however, there are many steps which may be performed by employes of a telephone company without running the risk of causing unfavorable comment.

A complete telephone valuation consists of an inventory; the pricing out of this inventory through the medium of properly prepared unit costs; the determination of the accrued depreciation of the physical property as of the date of appraisal; the determination of the collateral construction costs and, finally, the computation of the cost of establishing the business attached to the property.

The tabulation of the inventory data (especially the field count of the outside plant); a portion of the work involved in gathering together the material price data and labor cost data used in computing the unit costs and—if, most carefully supervised, the work of recording the actual condition of the property are all phazes of the total appraisal problem so constituted that they may be carried out (at least to a very large extent) by employes of a telephone company. The foregoing statement is predicated upon the assumption that careful rules and instructionse (such as the rules and instructions incorporated in this series of articles) are first laid down and that, subsequently, the work is most carefully supervised by a thoroughly experienced and competent appraisal engineer.

With respect to the foregoing suggestion—the use of company employes in appraisal work—the writer has had experience in a number of cases where such procedure has been adopted—with most satisfactory results (insofar as both bankers and commissions are concerned) and a very material *saving* effected in cennection with the total cost of appraisement. This point, I believe, is one which will prove of real interest to the operating executives of both large and small telephone companies.

In connection with the subject matter presented in this series of articles it may be well to follow the general form prescribed by the Interstate Commerce Commission for the accounting of Class A telephone companies.

To refresh the reader's mind the following synopsis is given showing the inter-relation of accounts for Class A companies:

Description of Property listed under Account	Acct. No.
Right of Way	207
Land	211
Buildings	212
Central Office Telephone Equipments	221
Other Equipment of Central Offices	222
Subscriber's Station Apparatus	231
Subscriber's Station Installations	232
Interior Block Wires	233
Private Branch Exchanges	234
Booths and Special Fittings	235
Exchange Pole Lines	241
Toll Pole Lines	251
Exchange Aerial Cable	242
Toll Aerial Cable	252
Exchange Aerial Wire	243
Toll Aerial Wire	253
Exchange Underground Conduit	244
Toll Underground Conduit	254
Exchange Underground Cable	245
Toll Underground Cable	255
Exchange Submarine Cable	246
Toll Submarine Cable	256
Office Furniture & Fixtures	261
General Shop Equipment	262
General Store Equipment	263
General Stable & Garage Equipment	264
General Tools and Implements	265
Materials & Supplies	122

Fig. No. 1.

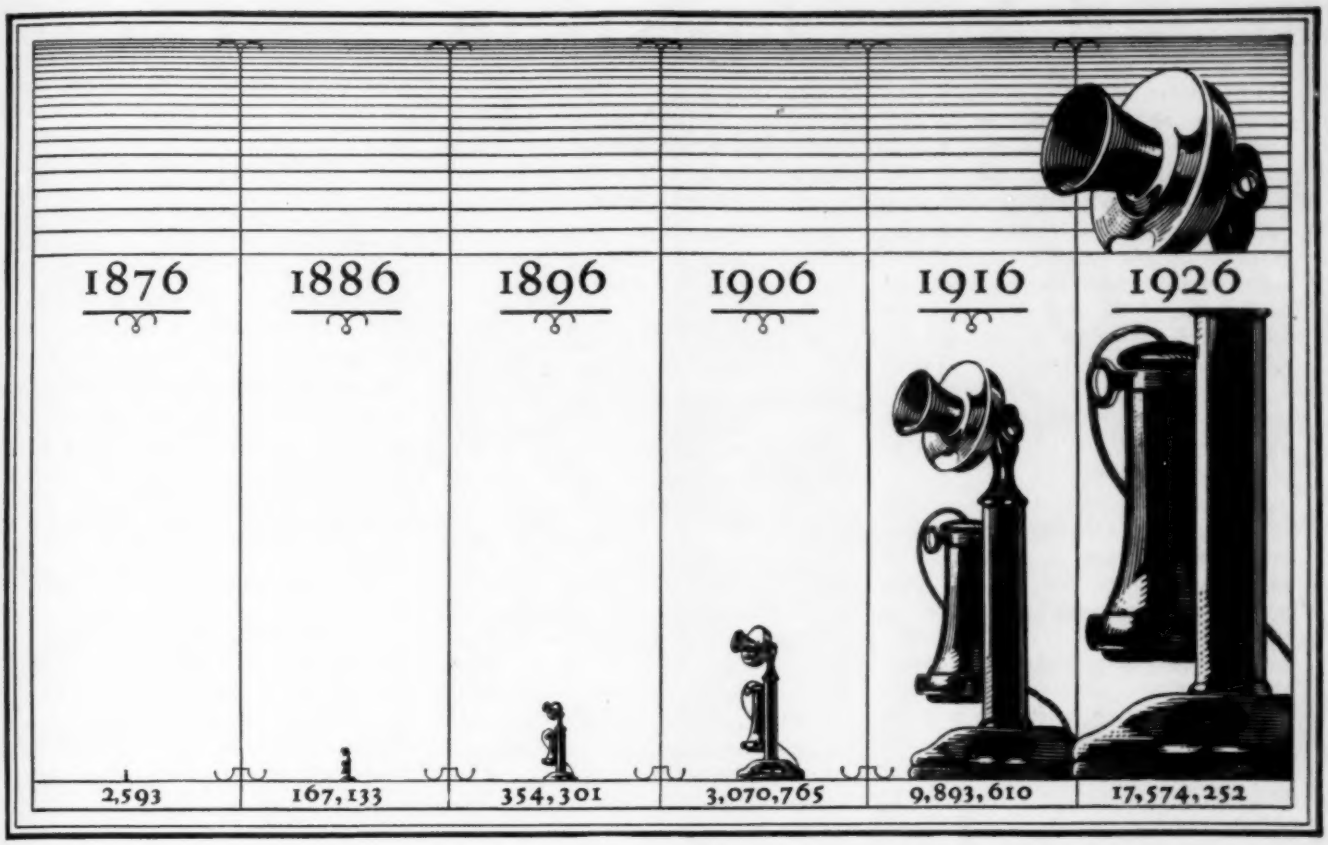
The foregoing tabulation—which for purposes of convenience in connection with this series of articles—we may refer to Fig. No. 1, incorporates a complete summary of all of the major items of Inventoriable Property.

Again returning to the problem, as viewed from the standpoint of a telephone executive who is going to make his own inventory, let us first consider the item Land, Account 211. The item Right of Way, Account 207 may be discussed to better advantage at a later date.

Land Account, 211.

The Interstate Commerce Commission says that this account (Land) should include the cost of all land and interests in land, other than right of way, acquired for use in the operation of the telephone plant, such as land occupied by

*Consulting Telephone Engineer, 448 Wrigley Building, Chicago, Illinois.



Milestones in National Service

An Advertisement of

the American Telephone and Telegraph Company

THERE are twenty-five Bell companies but only one Bell System —and one Bell aim and ideal, stated by President Walter S. Gifford as:

"A telephone service for this nation, so far as humanly possible free from imperfections, errors or delays, and enabling anyone anywhere at any time to pick up a telephone and talk to anyone else anywhere else in this country, clearly, quickly and at a reasonable cost."

The past year brought the service of the Bell Telephone System measurably nearer that goal. Seven hundred and eighty-one thousand telephones were added to the System—bringing the total number interconnected in and with the Bell to more than seventeen and a half million. The number of applications waiting for service, including those in new and outlying sections, was reduced fifty per cent.

A third transcontinental telephone line was completed to the Pacific coast.

The largest number of miles of toll wire for one year was added to the System—more than 664,000 miles.

The average length of time for completing toll calls throughout the System was lowered by thirty-five seconds.

A seven per cent improvement over the previous year was made in the quality of voice transmission in toll calls.

An adjustment was made in long distance rates amounting to a reduction of about $3,000,000 annually.

general and central offices, shops, stables, garages, storehouses, etc. It includes the cost of examination and registration of title conveyancer's and notary's fees, purchasing agent's commissions or proportion of purchasing agent's salary, taxes accrued to date of transfer of title, and all liens upon the title, when such costs are assumed or paid by the purchaser in his own behalf; cost of assessments for public improvements which add to the value of the lands but which are not the property of the accounting company; cost of grading land when not done in connection with buildings; and costs of obtaining consents and payments for abutting damages and expenses of condemnation proceedings.

"This account should also include the first cost of acquiring leaseholds of land, other than for right of way, the terms of which are more than one year each, whether acquired through direct lease, assignment or otherwise (but not including the rents paid periodically in consideration of rights obtained under such leases). If any such leasehold is acquired by assignment the charge to this account must not exceed the amount actually paid therefor by the accounting company to the assignor."

In nearly all public utility cases Courts and Commissions have ruled that the land should be appraised by a qualified real estate expert—and not either by the company owning the property or by the consulting engineer who is responsible for the valuation. Hence, it is well to retain a local real estate expert who is thoroughly familiar with real estate values and require him to prepare a detailed description and valuation of all of the land.

Despite the attitude of Courts and Commissions, however, it is wise for the company's manager to check the real estate expert's findings. This may be readily accomplished by obtaining historical data as to recent real estate transfers for comparable property in the immediate locality. By "comparable property" is meant property of approximately the same value—or at least equally desirable. Such property does not, of course, have to be of the exact size of the lot under appraisement. A figure per front foot may be obtained—in connection with such recent real estate transfers—and this front footage unit applied to the property under appraisement. If the real estate expert has done his job well, the resultant valuation—as made by the company's manager—should be very close to the figure obtained by the real estate expert.

Buildings, Account 212.

The writer does not like to repeat, word for word, the language of Interstate Commerce Commission in connection with the various accounts—but it is *most important* that those responsible for a given appraisal should *know exactly what they are appraising.* The Interstate Commerce Commission has expressed its instructions in terse language and it is thought that a repetition of this language may be better than the writer's own, more or less rambling, exposition of this phase of this subject.

With respect to the item "Buildings" the Interstate Commerce Commission says:

"This account should include the cost of all buildings, such as general and central offices, shops, stables, garages, storehouses, etc., devoted to the general purposes of the company; also of all permanent fixtures, such as water, steam and gas pipes and fixtures; electric wiring and fixtures for lighting, signalling, etc.; elevators and the engines and motors specially provided for operating them; furnaces, boiler and other apparatus provided for producing steam for such engines and for heating; electric generators specially provided for producing current for lighting such buildings, etc.

"This account includes such piers and other foundations for machinery and apparatus as are designed to be as permanent as the buildings in (or in connection with) which they are constructed, and to outlast the first machinery or apparatus mounted thereon. It also includes the cost of real estate broker's commission, examinations and registrations of titles and other expenses, such as architect's fees, supervision, etc., incident to the construction or purchase of buildings, and the cost of grading and of sidewalks, fences, hedges, etc., on grounds used in connection with such buildings.

"It does not include any telephone equipment, wiring or apparatus for generating or controlling electricity for operation of the telephone system."

With respect to the item "Buildings" my suggestions are simple and, I think, to the point. If possible, get the contractor who built the buildings to make a present day reproduction cost valuation. In other words get him to tell you how much it would cost to build the same buildings today. Of course, if it is not possible to get the original contractor—obtain the service of some reputable building contractor, or architect, and have him go over the buildings in detail and submit a certified statement to you as to the present reproduction cost of the buildings.

I shall have more to say with respect to the subject of buildings when it comes to a consideration of the general problem of depreciated values.

The next group of items—if we follow the chronological order prescribed in the table presented in Fig. No. 1—includes the central office equipment and the subscribing station equipment. As a rule, however, in making an actual valuation, work of this nature is deferred until after the inventory of the outside plant has been made. The reason for this will be obvious—the outside plant covers a lot of territory and should be inventoried while weather conditions are favorable. The central office and subscribers' station equipment can be listed and appraised during inclement weather or, if the job happens to be a rush one, by working a little while over time evenings.

Inventory of Outside Plant.

Hence, we will consider the outside plant (which, of course, includes the poles, pole equipment, aerial cable, aerial wire, underground cable and conduit, etc.) before taking up the subjects of subscribers' station and central office equipment.

One of the first things to be considered in connection with the inventory of the outside plant is the selection of men suitable for doing this portion of the work.

A plan which has been followed by the writer, with success, and which was also recently utilized by the Bell Telephone Company of Canada is the following:

Assemble one or more two-man inventory gangs. One man, the "Observer," should be a well-seasoned practical telephone man—perhaps a lineman or all around "utility" man. The other man, the "recorder," should be conversant with telephone property in a general way—but need not have a detailed knowledge of it. The recorder, however, should be neat and orderly as to the setting down of figures; quick and intelligent and capable of making small maps and sketches when needed.

A gang of this kind should be thoroughly tried out, or tested, before being permitted to do actual field work. Typical pole lines, aerial cables, etc., should be selected—and the two-man gang set to the task of recording all pertinent data. Subsequently the resultant work should be checked over by whoever is in charge of the appraisement and every effort made to eliminate inherent tendencies toward error at this early stage of the game.

This subject of inventory of the outside plant will be discussed more in detail in the August installment and the descriptive matter will be accompanied by illustrations of field recording forms, maps, etc.

Lamont, Wash. — Lamont Farmers Telephone Co. incorporated by James Philips, C. E. Morton, W. S. Schell and others.

Royal Center, Ind.—Max Hosea, Indianapolis, has bought local telephone company.

How to Read Telephone Circuit Diagrams

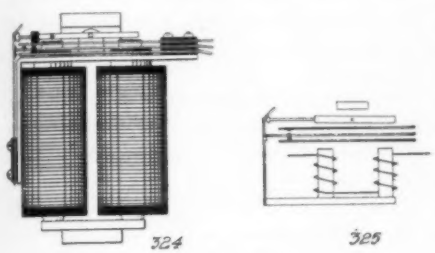
By DAVID S. HULFISH

CHAPTER VI

(Copyright, 1927)

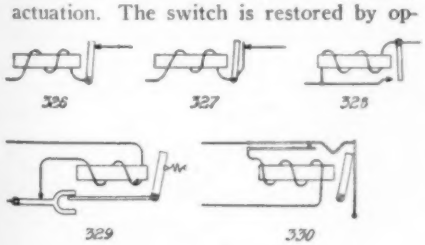
It is required sometimes of a piece of appartus that it perform its operating functions upon the cessation of the energizing current, rather than upon the beginning of the current.

A locking relay of such a nature is presented in mechanical detail in Fig. 324 and a symbol is presented in Fig. 325. The vertical spring at the left is a locking spring. It is provided with two teeth



Figs. 324 and 325

for locking purposes, and with an inclined surface to receive the thrust for unlocking. The armature may be tipped in either direction. When the left end of the armature is drawn downward by the the magnets, the insulating block of the armature pushes down both the upper and lower springs, until the long spring is caught between the teeth of the locking spring. When the energizing current ceases, the armature is released and the top and bottom springs are released, moving upward by their own spring tension, but the long spring is detained by the locking spring. Thus the upper spring moves away from the long spring and the under spring moves upward into contact with the long spring, and the condition of the switch is changed, the change being effected upon the release of the armature, rather than upon its primary actuation. The switch is restored by operating the armature in the other direction. The rising of the left end of the armature presses the locking spring away from the long spring of the switch.



Figs. 326-330

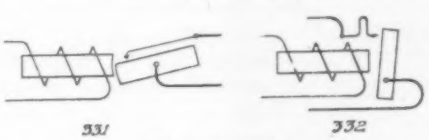
Vibrator magnets form the subjects of the symbols of Figs. 326 to 330. Fig. 326 shows a device whose helix is wired through its own back contact. When a constant potential is applied to this device, the core is energized, attracting the armature and breaking the energizing circuit; the core, thereby, is deenergized, releasing the armature and again closing the energizing circuit. Such a device is the battery buzzer. With a tapper upon the armature and a gong adjacent, it becomes the symbol for a vibrating bell. In the symbol of Fig. 327, a yielding spring continues the electrical contact and reduces the rapidity of vibration of the armature. Fig. 328 shows a closed-circuit vibrator, since it does not open its helix circuit, shunting its helix instead by its own contact to release its own armature.

Two vibrator magnets which are specialized to secure a long swing to their armatures are shown in Figs. 329 and 330.

In Fig. 329, the core is energized and after the armature has moved through its full swing toward the core, the tongue attached to the armature engaged the lower branch of the *Y* and opens the contact. The core is not energized again until after the armature has completed its full return swing.

In Fig. 330, the armature pushes up the upper spring of the switch; the vertical locking spring then drops under and holds the switch open. The armature now must accomplish the full return swing to knock the locking member from under the switch spring before the helix circuit can be closed again.

Alternating current relays are shown

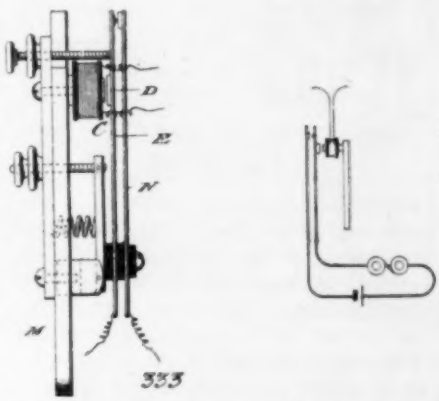


Figs. 331-332

in Figs. 331 to 339. The distinction which classes an alternating current relay is the function of closing the controlled circuit continuously in response to an alternating current. An ordinary relay with quickly acting armature will vibrate its armature in response to an alternating current through its helix.

A relay having a sluggish armature will attract its armature in response to alternating current and the armature, because of its sluggish movements, will not fall back between impulses sufficiently to permit its controlled circuit to break. A yielding contact member is required to retain the closed circuit during the vibration of the armature. Because of the weight of the armature involved, such relays as represented by the symbols of Figs. 331 and 332 usually are not sensitive to weak currents.

The relay shown in some mechanical detail in Fig. 333 and in symbol in Fig. 334 is designed for operation in response to very small and very rapid currents. In this relay, the permanent magnet *M*, of horseshoe form, carries the pair of electromagnets *C*. The armature *D* is attached to the spring *E*, which is adapted to make contact electrically with the companion spring *N*. Various adjustments are provided.



Figs. 333 and 334

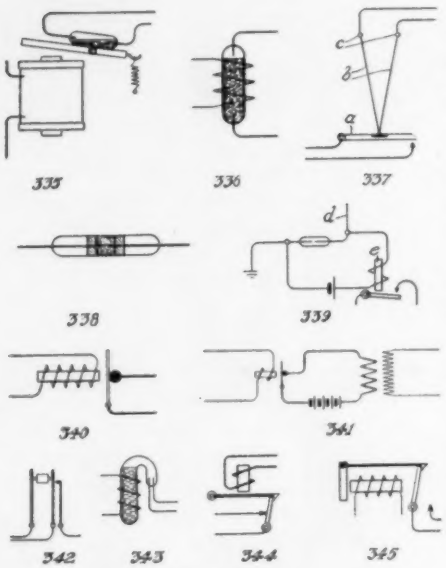
Figs. 335 to 343 show a few selected symbols typifying relays which involve special methods of controlling the local circuit.

Fig. 335 shows a symbol for a relay in which the contacts are adapted to be closed by a body of mercury which by the inclination of the armature becomes so placed in a sealed glass tube, or cell, that the circuit is opened or closed as required.

Figs. 336 and 337 show thermal relays. In the symbol of Fig. 336, a sealed mercury cell is represented together with a coil for heating the mercury. By heat from the operating helix, the mercury expands, rises in the cell, and touches the upper wire end. In Fig. 337 the terminals *C* are fixed, and the arm (or armature) *a* is held away from its contact by the

wires b, which are attached, at one end, to the armature, and, at the other, to the fixed points *c*. When current is passed through the leading-in wires at the top of the symbol, thereby passing through the wires *b*, which form the actuating, or controlling element of the device, the wires *b* become heated and expand in length. The expansion of the wires *b* permits the arm to be lowered to touch its contact point, closing the local circuit of the device.

Fig. 338 shows the usual symbol for a



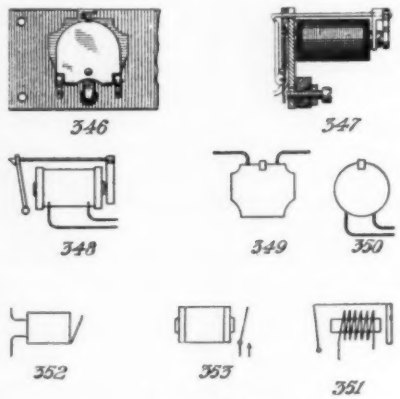
Figs. 335-345

coherer. This device consists of a glass tube containing two wire ends slightly separated, the chamber in which the separated ends are held being filled with fine metal granules. The coherer normally has a high resistance, but when a small current passes through it, the resistance is very greatly decreased, due to the tendency of the metal granules to crowd closely together, or to "cohere." An agitator is required in practice to shake the granules apart after the cohering or controlling, current has ceased, but this detail seldom is shown in the symbol. Fig. 339 shows the coherer connected for receipt of messages by wireless telegraphy. The aerial wire *d* is connected through the coherer to earth. The coherer also carries a small current from battery in series with the relay *e*. Because of the high resistance of the coherer, the relay *e* is not energized, but when any current flows from the aerial wire *d* to earth, the resistance of the coherer is decreased, and the current from the battery becomes of sufficient strength to operate the relay *e*. Upon cessation of current from *d*, the coherer returns to a high resistance, and the armature of the relay *e* accordingly is released.

Telephone relays, or speech current relays, are shown in Figs. 340 and 341. Fig. 340 shows the symbol used for this device, it being borne in mind that almost any form of electromagnet may be placed as the left-hand element of this symbol, and almost any transmitter symbol may be placed as the right-hand element.

In Fig. 341 are shown simple circuits for this device.

Circuit controlling devices which may be energized to change a local circuit, but which may not be actuated thereafter to restore the local circuit, are in the nature of locking relays. Fig. 342 shows a heat coil device in which the two main springs are held together by a heating element, which also connects them electrically. Current through the two wires leading into the symbol at the left, if of sufficient strength, will so heat the bridging element as to cause it to release the springs from each other, whereupon the circuit between the two springs is broken, and the right-hand main spring moves into contact with the contact spring near it. In Fig. 343, the helix, with sufficient current, will heat the mercury in the bent glass tube until there flows over the bend of the tube a sufficient quantity of mercury to connect electrically the two wire ends which are sealed into the shorter end of the tube. In Fig. 344, the



Figs. 346-353

electromagnet will withdraw the latch, thereby permitting the vertical lever to fall and to break permanently the electrical circuit of the contact. In Fig. 345 the energization of the electromagnet will release the drop shutter. In each of these tripping relays, the actuating current is unable to reset the device.

The voice-current relay of Fig. 340 produces an alternating current in its local circuit in response to an alternating current in its controlling helix. By this function, it does not fall within the definition of alternating-current relay as above given, although on final analysis, it is the only device of this group of symbols which truly relays an alternating current.

The signal used upon the switchboard, and by which the subscriber signals to the operator that attention is desired, is a visual device usually quite silent in its operation. The earliest type was the annunciator drop. When the shutter had been released, it was necessary to reset the device by hand. An improvement was made in drops which might be reset electromagnetically, and in mechanical signals which might be displayed so long as the electromagnet remained energized, and which would reset automatically when the energization ceased. The latest type is the incandescent lamp.

Figs. 346 and 347 show in mechanical detail front and side view respectively of

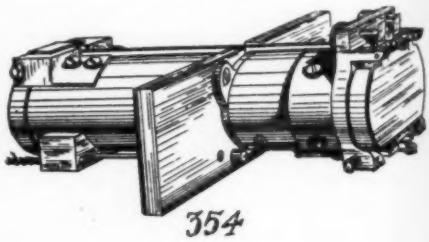
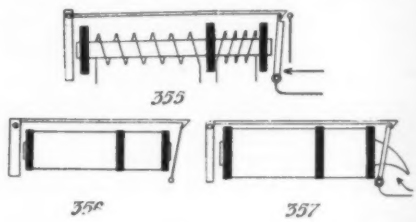


Fig. 354

a switchboard drop of simple type. Figs. 348 to 353 inclusive show symbols used for switchboard drops. Fig. 353 shows a symbol in which the alarm contact is shown.

A perspective view of a self-restoring drop is shown in Fig. 354. Such a drop is provided with two independent electric circuits. One circuit is effective in operating the magnetic latch to trip the shutter for display, and the other controls devices adapted to restore the shutter.

In the illustration, Fig. 354, the rear magnet is energized, the rear armature is attracted, lifting the reed and releasing



Figs. 355-357

the front armature, which by a slight movement sets the light shutter to display. By energization of the front magnet, the front armature is attracted, restoring the light shutter, regardless of the energized condition of the back magnet.

Figs. 355 to 357, inclusive, show symbols for self-restoring drops. Fig. 355 shows a symbol which may be considered as taken from the drop shown in Fig. 354.

In Fig. 357 the shutter is magnetic and the restoring coil is provided with an extension polepiece for attracting the shutter through a wide angle.

Mechanical detail of another type of self-restoring drop is shown in Fig. 358. The operation is simple and the illustration seems self-explanatory.

In Figs. 359 and 360 details of drops are shown which carry one of the functions of the locking drop. When the front or left-hand coil of the drop is

energized the shutter cannot be tripped by the back or right-hand coil. In the upper figure the locking coil holds the magnetic armature from falling; in the lower picture the locking coil holds the magnetic reed from lifting.

It is required that the switchboard drop give an audible signal. This leads to the design of a combined ringer and drop, such as is shown in mechanical detail in Figs. 361 and 362. Suggested symbols

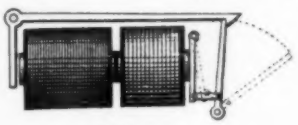
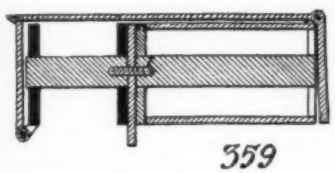


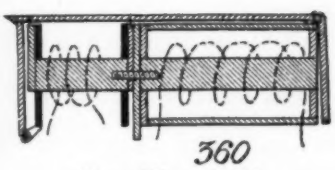
Fig. 358

for such a combined device are shown in Figs. 363 to 365 inclusive.

The three symbols here suggested show well how a standard symbol may be modified to indicate a modification or specialization in the piece of apparatus represented by the symbol.

In the class of apparatus called drops, the signal is set when the magnetic latch is operated and the signal remains set until some action is taken to restore it.

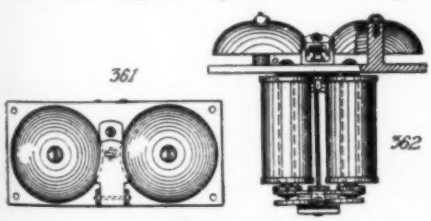




Figs. 359 *and* 360

The term "visual signal" has been used to designate a mechanical device operating to display a signal by changing the position of a movable part of the device, the movable part having two positions, one of which it holds during the time when the core is energized and the other of which is its position of rest. Such devices are shown in Figs. 366 to 378, inclusive.

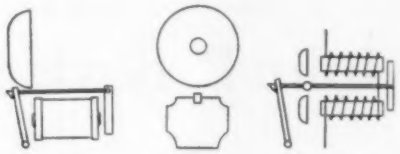
A set of common symbols used for incandescent signal lamps is shown in Figs.



Figs. 361 *and* 362

379 to 384, inclusive.

Fig. 385 presents a line circuit using a lamp signal, as an exercise in circuit reading. It may be seen readily by tracing the circuits and assuming proper operation of the different devices of the symbols that the hook switch at the substation controls the glowing of the lamp at the central office, and that by working the hook lever up and down the lamp can be caused to flash again and again. It may be seen also that upon the insertion of a plug in either of the multiple jacks, in response to the lamp signal or for purpose of calling the subscriber, current must flow from the body of the jack to earth through the "cut-off" relay, the upper of the two relays, which by opera-



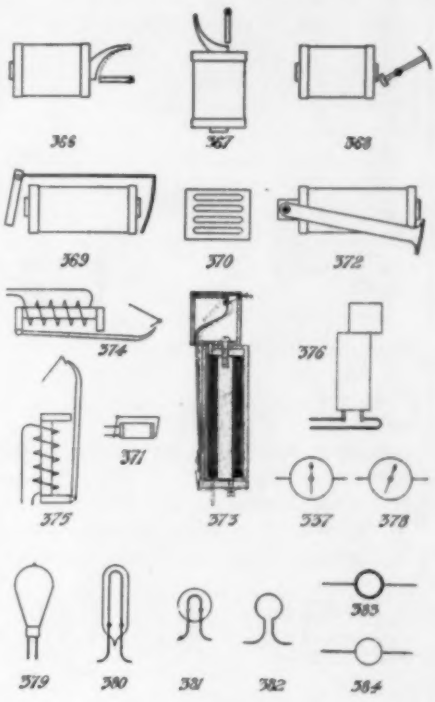
Figs. 363-365

tion of its armatures will remove the lamp from control of the substation hook switch so long as the plug remains in the jack.

Telephone registers usually have the function of recording the number of calls or conversations originating at a substation, although the register may be either at the substation or at the central office. The symbols used for registers consist wholly or in part of a representation of the counting train, or of the casing which contains it. This simplest form, without circuit connections, gives the symbols of Figs. 386, showing face view of the dials, and 387, showing side view of a well known type of counting device. The symbol of Fig. 390 repeats Fig. 386 with the addition of electromagnet and armature, while the symbol of Fig. 391 bears the same relation to that of Fig. 387. The electromagnet with armature and ratchet

heavier currents of the common sources of energy of the central office, will be found to be represented by appropriate symbols, just as are the items of apparatus which are specifically telephonic in nature.

Symbols for motors and generators of



Figs. 366-384

divers types are shown in Figs. 393 to 412. In Figs. 413 to 417 are shown symbols for pairs of machines or machines having the double function of motor and generator at the same time, called variously motor-generators, dynamotors or rotary transformers.

A motor may be run as a dynamo or a dynamo may be run as a motor, if desired, the machine being adapted to con-

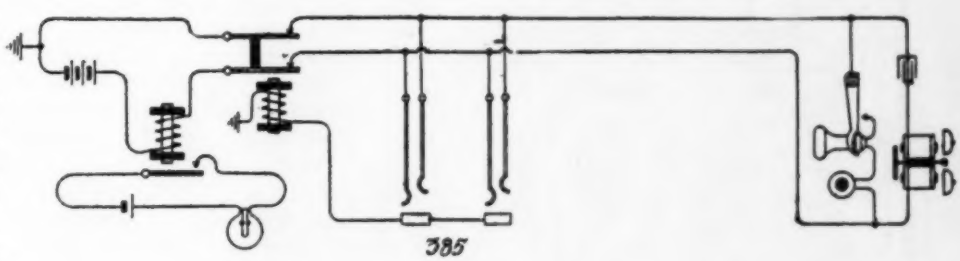


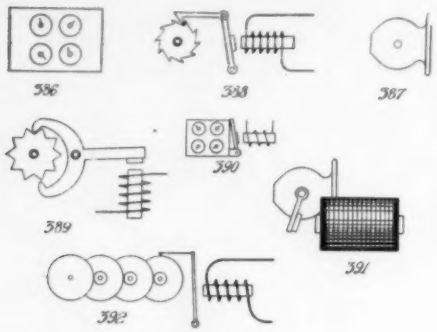
Fig. 385

shown in Fig. 388 is a symbol going into the detail of operation of the first wheel of the counting train; this symbol is amplified in Fig. 392. In Fig. 389, the star ratchet is driven by the teeth of the double pawl alternately. The ratchets shown have ten teeth, indicating their association with the usual decimal system of notation.

In the circuit drawings of a complete telephone exchange or system, the power apparatus, or apparatus carrying the

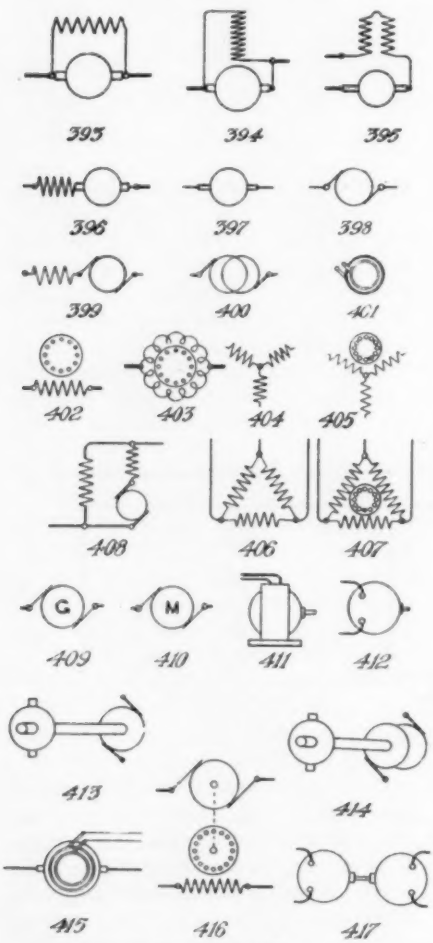
vert electricity into motive power or motive power into electricity, receiving either form of power that may be supplied to it and in turn supplying the other form. Any distinction which exists between the symbol for a motor and the symbol for a dynamo must be a purely arbitrary distinction. Compare Figs. 397 and 398. The former, with the radial brushes, is accepted as a general symbol for a direct-current motor; the latter with the tangent brushes is accepted as

a general symbol for direct-current dynamo or generator. These symbols represent end view of armature or commutator only, and this element is accompanied sometimes by a representation of the field winding of the machine to indicate the shunt, series or compound nature of the field winding. A series motor is represented in the symbol of Fig. 395,



Figs. 386-392

and shunt motors are represented in the symbols of Figs. 393 and 394. A generator with compound field coils is shown in Fig. 408. Motors and generators may be distinguished by the further means of



Figs. 393-417

adding the letter *M* or *G* to a simple symbol, as illustrated in Figs. 409 and 410.

In alternating current generator symbols, the two collector rings and their brushes usually are adopted to represent generators of two-phase current; such symbols are shown in Figs. 400 and 401. A similar symbol consisting of three rings and three brushes doubtless would represent a three-phase alternating current generator. However, the three-phase generator usually is represented by a showing of the three windings of its armature, connected either in star or delta. Such symbols are shown in Figs. 404 and 406.

A characteristic of the induction motor for alternating currents is the so-called squirrel-cage armature, which therefore offers a distinguishing feature for a symbol for all such motors. Such an armature alone with leading-in conductors might well serve for a symbol for an alternating current motor, but it is commonly used in connection with a representation of field coils. Fig. 402 shows a symbol.

Figs. 411 and 412 show the case of the motor only; presumably Fig. 411 is a side view and Fig. 412 is top view. Either might be direct current motor or two-phase alternating.

(To be continued.)

John P. Boylan Made Rochester President

Rochester, N. Y.—John P. Boylan has been appointed president and general manager of Rochester Telephone Corporation to fill the vacancy caused by the death of George R. Fuller. Mr. Boylan will also take Mr. Fuller's place as a director and member of the executive committee.

A new office, chairman of the board of directors, was created. Fred C. Goodwin was elected to this position. Wm. J. O'Hea, formerly assistant to the president, succeeds to the position of secretary, filling the place of Thomas J. Hargrave, who will devote his entire time to law practice. J. Foster Warner becomes a voting trustee.

Mr. Boylan came to Rochester in 1921 as vice-president and general manager of the then new Rochester Telephone Corporation. Twenty-four years of experience in the independent telephone field had qualified him to assume duties of that office. Success which has attended operations of the new company has, to a very large extent, been due to his efforts, it has been said. He is a graduate of the John Carroll University of Cleveland, Ohio, and entered the telephone field shortly after graduation.

Mr. O'Hea has been identified prominently with the telephone industry in Rochester since 1912. He has always considered the telephone company as an intimate and vital part of the community and has done much to keep the public informed about its operations. With the organization of the Rochester Telephone Corporation, and the election of George R. Fuller to the presidency, Mr. O'Hea was named by the directors as assistant to the president, and acted in that capacity until his election to the secretaryship. His close contact with Mr. Fuller gave Mr. O'Hea a deep insight into all of the affairs of the corporation.

Mr. Warner was elected by the remaining voting trustees to fill the vacancy caused by the death of Mr. Fuller. Mr. Goodwin and Mr. McCanne are the surviving trustees and they, with Mr. Warner, continue to possess voting control of a considerable majority of the company's common stock. Mr. Warner has been connected with the independent telephone interests in Rochester since 1899, when the Home Company was organized.

Mr. Goodwin was the unanimous choice of directors for chairman of the board. He has been identified with local independent telephone companies since 1910. As director, vice-president and general counsel, he has taken a prominent and important part in the solution of many perplexing problems of the old Rochester Telephone Company. Following his selection as chairman of the board, Mr. Goodwin resigned as vice-president.

Copperweld Buys Another Plant

Rankin, Pa.—The Copperweld Steel Co., announces the purchase of a 20-acre mill site improved with 10 acres of substantial brick buildings, with heavy steel reinforcement, at Glassport, Pa., just a few miles from the company's present location. The new plant will enable the company to consolidate all departments under one roof with a continuance of the control of every stage of manufacture, from raw material to finished product. Production will be maintained at the present Rankin and Braddock mills during the installation of the most modern mill equipment in the newly acquired buildings. It is planned to have the new mill completed and in full production January 1st, 1928.

Columbus, O. — McArthur Telephone Co. and Logan Home Telephone Co. have applied to commission for authority to merge.

LINE AND DESK

LOCATING "OPENS" IN TELEPHONE CABLES

An article on locating breaks on telephone cable conductors recently appeared in some of the Bell system employes' magazines. As it is of general interest we reproduce the following excerpt:

"How poor connections and breaks in the line are to be found has always been a challenging job for the telephone man. In the early days of the telephone art, the break might have been found by a thorough visual inspection of the lines, but the sharpest eyes and the most deft fingers would not suffice today. To walk or ride along the line from one end to the other, a distance of hundreds or thousands of miles perhaps, or to seek the break by visual inspection within the telephone office, is obviously impracticable.

"To locate these breaks electrically, to make the electric circuit itself disclose the point of difficulty, was the problem put up to the development and research engineer.

"At first the testboardman, by connecting a telephone receiver and battery between an open conductor and the ground, was able, by listening, to determine whether the break was quite close to the office or located miles away. If he heard a loud noise in the receiver he knew that the fault might be miles away from him, whereas if the noise were faint, he was fairly sure that the trouble was near the office.

"Later it became possible for the testboardman to determine the location of the break more accurately through the use of a testing method in which a voltmeter, battery and key replaced the telephone receiver.

"The testboardman afterwards using a testing device, known as a Wheatstone bridge. With this improved equipment he could make tests from the office and determine the location of a line break which was many miles away. These tests were accurate enough to warrant him in feeling quite confident that the line break or fault, although many miles from his office, would be found comparatively near to where his tests had indicated that the trouble would be. The Wheatstone bridge has saved time and expense in the location of faults on long distance telephone lines.

"In the last decade the use of long distance telephone service has greatly increased. With this increased traffic, many long distance telephone circuits have been built of stormproof cables instead of open wire. The number of breaks encountered in cable circuits is relatively small as compared to aerial wire lines and their location depends to a much larger extent upon electrical tests. In most cases, it is impossible to find or locate faults such as broken conductors by visual inspection of the cable, because all the conductors are enclosed in a lead sheath, and faults may develop in the conductors without apparent damage to the protecting lead sheath.

"As the result of recent developments the testboardman has been provided with fault location equipment which indicates the location of breaks with an accuracy far greater than had been previously possible. This equipment must be highly accurate because an error of measurement as small as one-tenth of 1 per cent gives an error of about 500 feet in the indicated location of a fault in length of cable about 50 miles which is the length of toll cable frequently involved in such a test.

"This new equipment has all the good features of the old Wheatstone bridge arrangement and is sufficiently accurate that in practically all cases a fault in a 50-mile division of cable may be located with a maximum variation of plus or minus one-half the length of a cable section. (A section is the length of cable between splices varying from 500 to 750 feet.) It, therefore, enables one to select, prior to the opening of the cable, one or the other of two existing splices between which the fault lies. A 4-cycle frequency of testing voltage is used to reduce certain errors which increase rapidly with higher frequencies.

"These new facilities, therefore, enable the testboardman and his associate, the cable man, to more effectively play their important role in the providing of reliable telephone service at the lowest possible charges."

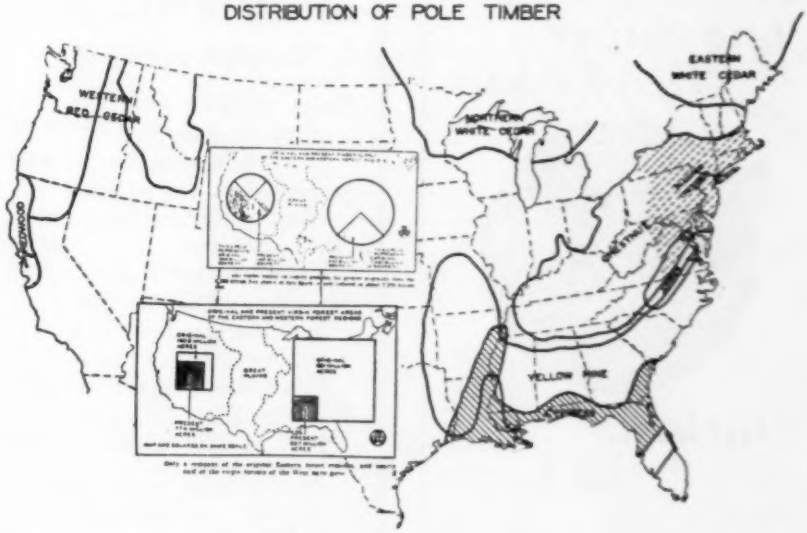
HELP! HELP!!

We have a letter from a subscriber who asks what an H-fixture looks like. While we could make a drawing, it has occurred to us that a photo might show the thing more graphically. Who can supply us with a snap shot of a good example?

THE SOURCES OF OUR POLE SUPPLY.

The distribution of pole timber and the various types of timber that are suitable for pole use if given proper preservative treatment is very interestingly shown in a map taken from an article by W. F. Bancker in Western Electric News.

DISTRIBUTION OF POLE TIMBER



BUGS WE HAVE SHOT

Some time ago, I was called to a telephone to investigate a report of "can't hear subscriber." I found the batteries were O. K. and started to test the transmitter. The subscriber had placed one

of the so-called sanitary protectors, a small celluloid disc, over the mouthpiece and when I took it off, I found what looked to be a roll of green paper. Upon investigating, I found that it consisted of several one-dollar bills. I asked the lady of the house when she started to use the telephone mouthpiece as a bank. She was somewhat puzzled but finally the source of the money dawned upon her. It seems that, her husband had the habit of inviting a few friend in for a friendly game of cards and that she had always refused their offers of a little contribution to compensate for the work of housecleaning after the party. They finally compromised by hiding the money in the telephone mouthpiece.—Contributed by C. R. Abdon.

RADIO INTEFERENCE FROM HAND GENERATOR

Dear Line and Desk:—Did you ever run across a case of radio interference due to a hand generator? Neither did I until a few months ago when we took over a small plant in a nearby town; usual type of plant, open wire, grounded circuits, pretty generally run down. One of the first things we did in fixing things up was to install a new magneto switchboard to replace the 1900 model we found. Shortly afterward we received complaints that the new switch board interfered with radio when the operator rang on the lines. We were skeptical and had to be shown and we were. It certainly did interfere. The long and short rings on the party lines banged the loud speakers plenty. We cleared the trouble in the usual way by using the special retard coils that are used on ringing machines and interrupters.

The interesting thing about it was the reason why we never heard of the trouble from the old board. It had a good five bar generator but never had caused any interference. We finally found out that the operators had been in the habit of ringing code rings by starting and stopping the generator. When we installed the new board, in testing out some of the lines I rang the code by operating the ringing key and one of the operators seeing it began to use the key instead of starting and stopping the generator. We found that the old way of ringing did not cause interference while the new way did. This was probably due to the fact that the voltage built up gradually while the new way put the full voltage of the generator on the line when the key was pulled. The rush of current when the key was pulled was the cause of the shock on the loud speaker that was the cause of the complaint.—Contributed.

LONGHANDLED SHOVEL NO SUBSTITUTE FOR PIKE POLE

At this time of the year a plant man is thinking safety first with considerable emphasis and he's talking it too, because right ahead lies the big summer's job and accident prevention goes along with that work.

There are so many things—little things, too—that enter into the prevention of accidents, that it is almost impossible to select one particular thing and say that it is responsible for the "no lost time accident" records which are proudly held by a number of telephone crews in our Company.

"When we talk about safety on a job," said one plant man, "the conversation generally turns to tools, their uses and the condition they should be in.

"I remember once when we were putting up some poles. There wasn't any pike pole handy but there was a long handled shovel, so I gradded the spade, dug the edge into the pole and began to push. The spade slipped off the pole. No one was hurt, but it was just luck. The pole came down and so did the spade but fortunately no one was under either of them."

The story illustrates the point that certain tools are designed for doing certain work. Using the wrong tool not only interferes with the work but is a dangerous practice, as for example, using a long handled shovel as substitute for a pike pole.—Northwestern Bell.

Lincoln, Neb. — Platte County Telephone Co. of Delaware has bought properties of the Platte Valley and Wehn Telephone Companies in Nebraska and Wyoming. John H. Cook, Scottsbluff, Neb., heads purchasers.

Andalusia, Ala.—Ex-Governor Henderson and associates, who have bought the Andalusia Telephone Co., have appointed Chas. Henderson manager.

Mattoon, Ill.—E. A. Purcell, formerly general manager of the Illinois Consolidated Telephone Co., has been appointed vice-president of this organization and the Southeastern Illinois Telephone Co.

NEVER CREEP

The Super Dead Man

Outlasts the Line

Chance Company
Centralia, Mo.

Manfd. in Canada by N. Slater Co., Ltd.
Distributed in Canada by Northern Electric Co., Ltd.

STEEL HOTEL SETS
Complete and Tested

Dean Electric Co.
straight line $2.50
Harmonic ringers ... 3.00
Stromberg - Carlson (flush transmitter)
straight line 2.50
Harmonic ringers ... 3.00
Stromberg-Carlson (adjustable transmitter),
straight line 2.50
Harmonic ringers ... 3.00
Western Elec. Co., 1000, 1600 or 2500 ohm..... 6.00

Above telephones completely refinished — $1.50 extra.

Buckeye Telephone & Supply Company
Columbus, - - Ohio

BRIDGING twisted pair to twisted pair, a practical application of the Kearney Solderless Service Connector.

FOR Telephone Lines in making party line taps, order Catalog No. 86. The tap can't slacken off. This connector is for No. 12 wire or smaller.

Unassembled Connector

ASK ABOUT KEARNEY CERTIFIED MALLEABLE SCREW TYPE ANCHORS

Kearney Guy Wire Serving Clips. Eliminate Serving End of Strand. Made of Aluminum, Copper, and Galvanized Iron.

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

4226M Clayton Ave.

U. S. Telephone Center Is in Indiana

New York City.—The numerical center of telephones in the United States is now located in the state of Indiana.

Calculations which have recently been completed by telephone statisticians show that this numerical center at the beginning of 1925 was located in Huntington County, Indiana, at a distance of about twelve miles southwest of the city of Huntington and approximately thirty-nine miles due east of Logansport. This point is at the intersection of the 40° 45′ north parallel of latitude and 85° 37′ west meridian of longitude.

This point is the junction of the line dividing the number of telephones equally north and south with the line dividing them equally east and west, and, of course, is not identical with the "center of telephones" which technically is the center of gravity of all telephones in the United States and takes into account the distance of each telephone from a central point. To determine such central point would be extremely difficult.

From 1920 to 1924 this numerical center of telephones moved about one mile in a northerly direction and approximately thirty-nine miles in an easterly direction. Statistics are not yet available to show the movement of the point since the beginning of 1925, but the available data seems to indicate that the general easterly movement has continued since that time, but at a considerably lower rate. This movement apparently has been on about the same parallel of latitude, that is 40° 45′.

Tri-State Meeting at New York

Albany, N. Y.—A Midsummer Tri-State Telephone Convention will be held at the Jamestown Hotel, Jamestown, N. Y., July 14, 15 and 16.

It has long been the hope of telephone association executives that interstate meetings could be brought about with a view of establishing more intimate relations between telephone interests of adjoining states. This desire will be accomplished at the Jamestown convention, which will serve a dual purpose.

First—In bringing together the 9th and 10th New York State Districts for the regular summer meeting.

Second—In combining with the Pennsylvania Telephone Association and the Ohio Telephone Association, it will bring telephone men from other states, and will undoubtedly be the largest and most interesting telephone event of the season.

The united efforts of Mr. J. H. Wright, vice-president of the Jamestown Telephone corporation, and Mr. F. C. Saunders, president of the Allegany County Telephone Company, who are both Vice-Presidents of the New York Telephone association, representing re-

Interstate Commerce Commission's Depreciation Order No. 14700

How many telephone managers fully understand I. C. C. Order No. 14700 Depreciation Charges?

On Page 356 the order sets out clearly the distribution of the property subject to depreciation.

But the per cent applicable to each distribution is a matter that should receive careful consideration. Also the proper distribution of the capital accounts.

It is the intent of the Commission's requirement, that the plant investment be properly distributed over the capital accounts in fixing the rate of depreciation for the different distributions and then arriving at a composite rate for the entire property. It is very important that the investment be properly distributed.

There is very little said about current maintenance. Now I will not attempt to draw the line of demarcation between maintenance and depreciation, but it is a matter that should be approached with some degree of accuracy. My observation is that it is the tendency of some companies to keep everything repaired up to a high point of efficiency. With other companies working under precisely the same conditions—repairs are neglected.

Various opinions exist as to the amount of depreciation. Opinions are commonly the result of experience; and the nearer home the experience comes, the more positive each one will be in his convictions. One manager would declare positively that the life of a switchboard was eight years or less, because such has been his experience, while another manager would show an eight-year-old switchboard with the finish scarcely damaged and good for many years to come. Similar reports will be given by managers as to the amount of depreciation: one would declare ten per cent yearly is none too much to write off, while another would consider five per cent yearly a liberal allowance.

In determining the proper depreciation rate, in absence of a systematic valuation, all the facts which enter into depreciation must be given due consideration to make the percentage large enough to meet the aims and to protect the welfare of the business and yet not introduce too large a factor into plant cost. It is a matter of application no more difficult than the innumerable problems that surround the business and are daily taken up and satisfactorily solved by practical telephone men.

I am fully prepared to assist any telephone company in properly working out the order of the Interstate Commerce Commission as to depreciation.

SIX MONTHS' BUSINESS, ENDING APRIL 30, 1927
DETAILED APPRAISALS MADE

	No. Exchanges
Rochester Telephone Co., Rochester, Ind.	1
Commercial Telephone Co., Warsaw, Ind.	1
Velpen Telephone Co., Velpen, Ind.	1
Palmyra Independent Telephone Co., Fritchton, Ind.	1
Wautoma Telephone Co., Wautoma, Wis.	1
Theresa Union Telephone Co., Theresa, Wis.	3
Random Lake Telephone Co., Random Lake, Wis.	1
Eden Telephone Co., Eden, Wis.	1
Columbia Telephone Co., Columbia, Pa.	4
Albemarle Telephone Co., Charlottesville, Va.	1
Farmville Telephone Co., Farmville, Va.	1
South Branch Telephone Co., Romney, West Va.	9
	25

Additions to 1926 Appraisal Home Telephone Company, Elkhart, Ind.

APPRAISALS CONTRACTED FOR

Citizens Telephone Co., Decatur, Ind.	4
Vandergrift Telephone Co., Vandergrift, Pa.	3
Northern Neck T. & T. Co., Warsaw, Va.	4
Companies in Texas	26
	37

J. K. JOHNSTON, *Engr.*

903-4 LEMCKE BLDG. INDIANAPOLIS, IND.

spectively the 10th and 9th Districts, insure the best possible program and entertainment.

Mr. H. E. Bradley, President of the Pennsylvania Telephone & Traffic Association, Mr. C. L. Jones, President and Frank L. McKinney, Secretary of the Ohio Telephone association have assured a liberal attendance and many interesting features from those states.

This will be the first occasion upon which a tri-state telephone convention has been held and all telephone company officials in New York state regardless of location are urged to attend the meeting, bring their wives and send as many operators and other members of their organization as possible.

Clarence Anderson Allies With American Electric

Chicago, Ill.—Clarence A. Anderson, president of the West Mfg. Co., also is associated with the American Electric Co., now, in the manufacture and sale of West Test Sets. This alliance which was recently made also provides for the licensing of American Electric as maker and distributor of other West Mfg. Co. products.

For twenty-seven years Mr. Anderson has been actively interested in telephone work. He is a member of the Western Society of Engineers, Telephone Pioneers of America, and Railway Telegraph and Telephone Appliance association.

His has been a varied experience, serving in the manufacturing, operating and development of telephone apparatus. Beginning in the telephone business as an apprentice and rising to chief installer of one of the telephone manufacturing companies of Chicago, later serving in the telephone department of the Stromberg-Carlson Telephone Manufacturing Co., he then entered the operating field as manager of a small group of telephone exchanges in central Kansas. It was then, and on his own time, that Mr. Anderson developed and patented what is known as the "Anderson lock-out" party line system. Later he sold out his interest in the Kansas telephone companies and entered the employ of Western Electric Co. in Chicago, doing development work. Leaving Western Electric Co., he became chief engineer of the Anderson Electric Co., which was a holding company for "lock-out" patents. He has also developed a number of other patents, one of which is the well-known Anderson Trouble Finder Test Set, now the West Test Set.

In 1913 Mr. Anderson became associated with the United Telephone Co. of Abilene, Kansas, as Superintendent of Equipment, and in 1924 went to the Southwestern Bell Telephone Co., St. Louis, to work on automatic and machine switching equipment problems.

In 1926 he resigned his position with the Southwestern Bell Telephone Co. to become President of the West Manufacturing Co., which was then incorporated and began manufacturing the West Test Set on an enlarged scale for distribution throughout the U. S. A. and foreign fields.

Mountain Grove, Mo.—E. J. Frantz, Conway Springs, Kan., and W. F. Buchanan, Seymour, Mo., have bought Wright County Telephone Co.

Burton, O. — Burton Telephone Co. bought by Ohio Bell.

Pine Bluff, Ark.—Dollarway and Sheridan Pike Telephone Co. incorporated by M. F. McCain, M. L. Lowe and R. W. Woods.

Franklin, Ga.—Franklin, Sylvia, Bryson City and Clayton companies merged as Western Carolina Telephone Co.

Weatherford, Okla.—Ben P. Smith has bought from Sherman Mooter exchanges at Hanna and Indianola.

Edgeton, Minn.—Southern Minnesota Telephone Co. buys Edgeton Telephone Co.

Back of the Triumphs of Runzel-Lenz Cords Is Unending Vigilance

There is no guess work to the performance of Runzel-Lenz cords for the simple reason that there is no guess work in their making. Every ounce and every inch of raw material that goes into Runzel-Lenz is subjected to the most thorough tests before it is acceptable for our use.

Then cord specialists who have been with us for years use this raw material and our special machinery in making the completed product. As the last check-up the cords are rigidly tested before shipment.

With this extreme care in the laboratory and shop it's no wonder that the finished Runzel-Lenz cords are 100% certain to give you the utmost in cord value.

Write us for complete details of the extensive line of Runzel-Lenz cords for telephone company use.

RUNZEL-LENZ ELECTRIC MFG. CO.

Telephone Cord Making Specialists

1751 No. Western Ave. CHICAGO, Ill.

Fort Frances, Ontario, Plant in New Super-Service Dress

By LOUIS LA FLEUR

Ass't Manager Stromberg-Carlson Telephone Mfg. Co. of Canada, Ltd.

Geographically the town of Fort Frances, called western Canada's most progressive city, is situated in a strategic position in the center of a district rich in natural resources. The three basic resources of any country, timber, minerals and agriculture, abound. Ample railroads and improved roads center in Fort Frances placing this enterprising town in an enviable position as a center for a large territory. In addition to the commercial attractions the natural scenery and fishing attract the nature lover and sportsman.

In twenty years this community has grown from a settlement of 500 people to a thriving and prosperous town of over 5,000. The progressive men and women who have guided its development have recognized the importance of maintaining high standards not only in their private homes, many of which are remarkably beautiful, but also in the ownership and operation of the public utilities. The Town Council of Fort Frances has been very fortunate in their appointment of an aggressive public utilities committee and a general utilities superintendent, who have controlled in a highly satisfactory manner the water works, sewers, electric lights and telephones.

The original telephone installation consisted of one magneto position to which two additional positions were added. In 1926 the ultimate capacity of the magneto equipment had been reached and the town council called a meeting to vote upon a proposal to revamp the whole telephone system and install an up-to-date central energy plant that would take care of the anticipated growth for several years.

As the result of this vote, a delegate was sent to visit several modern switchboard installations and make a study of equipment which would handle their traffic more economically and more rapidly. Plans and estimates were received with the final result that a 3-position Stromberg - Carlson Super - Service Switchboard was installed.

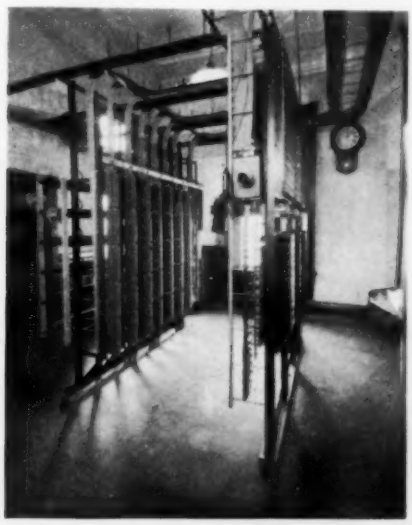
Town Hall Is Headquarters

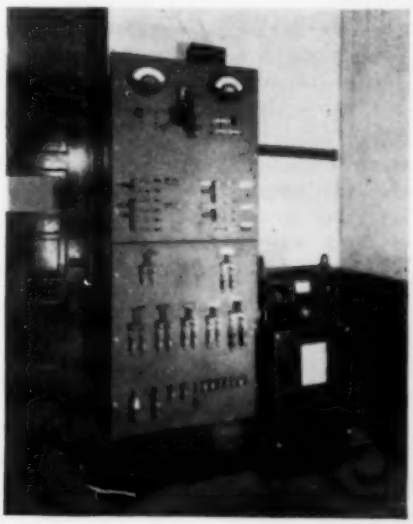
The Fort Frances Town Hall, which houses the town offices and provides commodious and accessible accommodations for the central office telephone equipment, is an imposing two story and basement building. The new switchboard, terminal and relay equipment occupy a convenient place on the first floor, while the battery equipment is located in the basement. For the convenience of the public two telephone booths are located on the main floor. In the rear of the building garages are located for the storage of trucks and employes' cars.

Six hundred subscribers are now receiving service from the Stromberg-Carlson Super-Service switchboard. Equipment is in place to serve 700 and the board is designed to take care of additional subscribers up to 1,500. Rural lines radiate throughout the district and long distance connections are established to the United States, Winnipeg and western towns, which places Fort Frances in close touch with all points.

The equipment necessary for handling toll and long distance calls is placed in the first position. The key shelf of this position is deeper in order to provide space for the calculagraph and room for writing out message tickets, while back of the shelf are pigeon-holes for storing tickets and traffic books. This arrangement places all necessary information and materials within easy reach of the operator. The modern circuits which are wired into this position make it possible to give rapid service on long distance calls and the calculagraph records accurately the elapsed time of all conversations, thus preventing errors and disputes in regard to charges.

The responsibility of seeing that all lines and apparatus are kept in proper operating condition rests upon the wire chief. For this purpose his desk is equipped with complete testing apparatus by means of which he can determine not only the nature of any trouble but also the approximate location. With this apparatus used by capable wire chiefs it is expected that both line equipment and central office equipment will be maintained in the efficient operating condition in which it was installed.





Left to right—St. Frances' new super-service board; cable racks and terminal frame in new plant; the power panel at St. Frances.

Power Equipment

The power equipment consists of a main storage battery, two smaller batteries, a mercury arc rectifier and a power switchboard. The main battery furnishes power for talking and signaling purposes and has a sufficient capacity to operate the exchange continuously for 72 hours, in case all outside sources of power should be cut off. The two smaller batteries are used in connection with the main battery to increase the voltage as required for toll and long distance connections. The batteries are charged through the mercury arc rectifier. On the power switchboard are mounted switches, meters and fuses necessary for controlling electric current used in the operation of the exchange.

All outside lines are brought into the exchange through lead covered underground cables which terminate on the terminal racks located on the same floor with the switchboard. For protection against accidental contact between telephone lines and power lines, or lightning, protecting fuses and lightning arresters are located on the terminal rack. Frames are also provided for carrying the cables in a convenient and accessible manner from the terminal and relay racks to the switchboard.

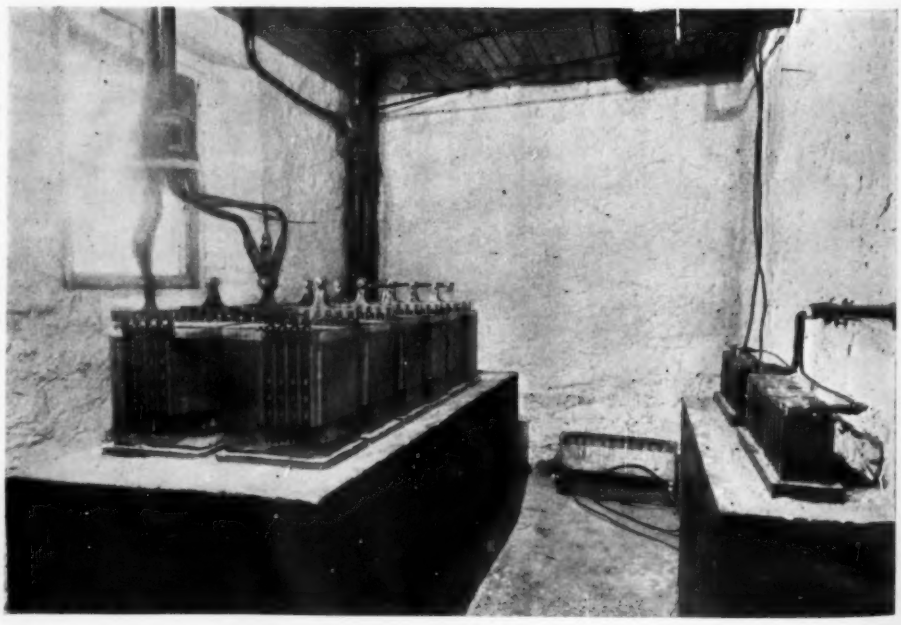
The switchboard, in addition to the regular Stromberg-Carlson Super-Service features, is distinctive in that all ringing keys are eliminated from the keyboard. The insertion of the calling plug in the jack starts the automatic ringing which continues intermittently until the called subscriber removes his receiver from the hook or the calling subscriber hangs up his receiver.

Here's where the St. Frances wire chief has his throne

This entire elimination of keys not only permits the operator to give much faster service than she could if it were necessary for her to select the correct key for each call, but also allows her to concentrate more thoroughly on the few operations which she must perform, thus tending to eliminate possible errors.

When a subscriber lifts the receiver of his telephone from the hook while making a call the action causes the illumination of two small incandescent lamp signals on the switchboard, one of which is directly in front of the subscriber's operator and the other in what is technically known as an associated lamp multiple. This is arranged so that any of three operators can answer the call and it has been found that a great percentage of the calls during the busiest hours are answered under the team-work plan, with greater speed than would be possible without this arrangement.

The connection between any two separate lines is made by means of a pair of flexible cords terminating in plugs designed to fit the terminal jacks of the lines with great accuracy. Each operator has eighteen pairs of cords before her with which she makes the connections for the subscribers whose lines terminate in her position. The circuits of these connecting cord pair equipment include a number of the latest improvements in telephone switchboard manufacture which are designed to increase the speed and accuracy of the service by lessening the work required on the part of the operator in handling each call.



This battery equipment serves the new St. Frances plant

To answer a call the operator picks up the answering plug of the cord pair selected and inserts it in the terminal jack of the calling line which is directly over the associated line lamp signal. This action automatically connects her talking set to that cord circuit and provides a talking connection with the subscriber.

After ascertaining the desired number the operator takes the calling plug of the cord pair used and touches its tip to the called subscriber's line jack. If the line is busy she hears a distinctive click which warns her that others are using the line, and so informs the calling party.

If the line is disengaged she inserts the plug in the jack. This action automatically disconnects her talking set from the line and prevents any subsequent listening to conversation between the connected parties.

Ringing Method

The insertion of the calling plug in the jack also starts the automatic ringing attachment which rings the called subscriber's bell intermittently and at regular intervals, without further attention from the operator. The ringing is stopped immediately when the called subscriber lifts his receiver to answer the call or when the party calling fails to get a response and hangs up his receiver. During the interval when the subscriber's bell is ringing the calling party hears a distinctive ringing tone which indicates that his wants are being properly attended to.

Another excellent feature which is incorporated in the new switchboard is the flashing recall system. This is for the convenience of subscribers desiring to make successive calls rapidly and eliminates the "jiggling" of the hook-switch to regain the attention of the operator after finishing a conversation with another subscriber. To operate the flashing recall the switch-hook is pressed down once only. This causes the answering supervisory lamp to flash intermittently until the operator again answers.

Each operator's position is equipped with counter so that every incoming call can be registered by the operator at that position. These meters show at a glance the exact number of calls handled by each operator and enables the management to distribute the work of the operators equally, thereby giving all subscribers uniformly good service. To further assist in the supervision of the operating force each operator's position is equipped with pilot lamps visible to the chief operator which indicate the time taken to answer calls and to effect disconnections.

In line with the installation of the new central office equipment all magneto telephones were removed from the subscribers' locations and replaced by central energy telephones. The subscribers were given their choice of three types of instruments:

The compact wall type, which is made of pressed steel and finished in black enamel. This type of telephone has concealed gongs and makes a very neat installation in any place where one ordinarily remains standing while answering calls.

The desk type, which is the usual instrument for offices and residences. Its rugged construction and attractive black finish with a nickel trim, its light weight and accurate balance make it a particularly convenient instrument to use. The desk set box which accompanies this instrument is of pressed steel, enameled in black and conceals the gongs.

The combination telephone, which is unequalled where one is limited for space or desires a very light weight telephone. It hangs from a small hook switch box fastened to the wall, side of the desk, or any vertical position.

With this new equipment installed the town of Fort Frances find that they can furnish telephone service at the very reasonable rate of $25.00 per year for private telephones and $30.00 a year for business telephones. The citizens of Fort Frances are fortunate that their committee has purchased equipment which will render, at so low a rate, telephone service equal to the best. The operators are highly trained and are eager to do their best to serve the subscribers. Even with this up-to-date and efficient installation this could not be done except for the careful management and conscientious work of the employes.

The management, after selecting Stromberg-Carlson Super-Service equipment, is anxious to keep its equipment in perfect condition, in order that its patrons may receive telephone service that is beyond criticism.

Star Speakers Feature Wisconsin Meeting Program

Madison, Wis.—A battery of star speakers, including George C. Matthews, director, securities division, Wisconsin Railroad Commission; Dr. Glenn Frank, president, University of Wisconsin, and a number of prominent telephone men, commission representatives and legislators, spoke before a splendid convention of the Wisconsin association, this being the 18th annual affair of the organization.

The association re-elected all officers, headed by Walter Gallon, Antigo.

Bert Arnold of the North Shore electric line opened the speaking schedule with an address comparing the communication and transportation companies with respect to service and regulation, pointing out the community of interest between the two industries in legislative and regulative matters. M. W. Torkelson, engineer-secretary of the Wisconsin Highway Commission, spoke on the use of highways by public utilities, calling for consideration of the utilities by the highway commission.,

The fireworks address of the meeting was given by George Matthews in telling about "Dangerous Tendencies in Utility Financing." Condemning the investment banking business for harboring people with little sense of responsibility to the customers and to business, Matthews became specific in telling of cases where the public is being "gypped" because of its faith in the stability of utilities. He pointed out the inability of telephone companies to greatly expand their markets and to effect great operating economies as points of difference in telephone company and power company mergers.

Inexperience of promoters in the telephone industry he also cited as another hazard. He also told of what the Wisconsin commission is doing to regulate issues of telephone securities, telling of one case where a company was refused to sell telephone company notes in Wisconsin.

J. F. Krizek, general attorney of the Wisconsin Telephone Co., reviewed the legislation proposed and enacted to affect Wisconsin telephone companies. The association took steps to protest against two unfavorable tax bills. Another speech on legislative and court matters was made by Lewis E. Gettle, chairman of the Wisconsin Railroad Commission, in an interesting paper on "Recent Court Decisions Affecting Utility Problems."

President MacKinnon of the national Independent organization told the convention he had no fear of an undue raise in telephone rates to help the wildcat financiers out of the hole in which they may find themselves. The commissions are on the job, stated the Independent chief. He also referred to the activities of the promoters and outlined the work that the national association is doing to protect Independent interests.

At the banquet Thomas Duncan, a state assemblyman of Milwaukee, talked on his "Gross Net Tax," and Dr. Glenn Frank, president of the state university, addressed the banqueters on "The New Spirit in Business."

During the concluding session "Some Problems of the Small Telephone Exchange," by John A. Pratt, and "The Tree Problem in Telephone Work," by Jesse T. Walker, were presented, both being of considerable practical value to the conventioners.

Studying the Details of Telephone Work

By E. R. COLLINS
Wire Chief, Manitoba Telephone System

CHAPTER VI

We have studied briefly two forms of electrical energy, direct current and alternating current. Direct current was produced by chemical means, or was the result of the chemical action of the different elements in a battery. Such current will flow continuously in one direction through the conductor which connects the two poles of the battery. Direct current can also be produced by electro magnetic disturbance, or by the direct current generator, or dynamo as it is commonly called. The arrangement used to compel the output from such a machine to travel in one direction, is called a commutator. This will be more fully dealt with under another heading.

Alternating current can be produced by reversing the direction of a battery flow at certain time intervals, such as we find in a pole changer or interrupter. Alternating current is also produced by electro magnetic induction as a result of a rise and fall of magnetic field, due to some magnetic disturbance. Alternating current will continue to flow back and forth along its circuit as long as the interrupter or alternating current generator continues to supply the alternating disturbances. The direct current is an even flow, and the alternating is also an even flow of electrical energy, depending on the conditions mentioned.

Another form in which electrical energy is found is called static electricity. This is due to the power of certain substances to store up electrical energy and hold it for periods of time, and still be able to let it all go as soon as a circuit is provided for its flow.

Static Electricity

Static electricity has for its best example the discharge of electrical energy in the form of lightning from the clouds. Due to friction, and sudden changes of temperature, charges of electrical energy are accumulated by the clouds and retained until the pressure is so high, that the charge, which we will say is of negative polarity, comes within a reasonable distance to another body of a positive polarity. As unlike poles attract, in magnetic action, so unlike charges of electricity attract each other, the result being when the attraction is strong enough, the stored up energy will jump from one body to the other.

A very simple example of static electricity can be had by placing 4 insulators on the floor, and laying a board over them. Then have one of the boys stand on the board. Now with a piece of fur, or a silk scarf, strike him over the back a few times, and then step up to him and hold your finger toward his ear or nose.

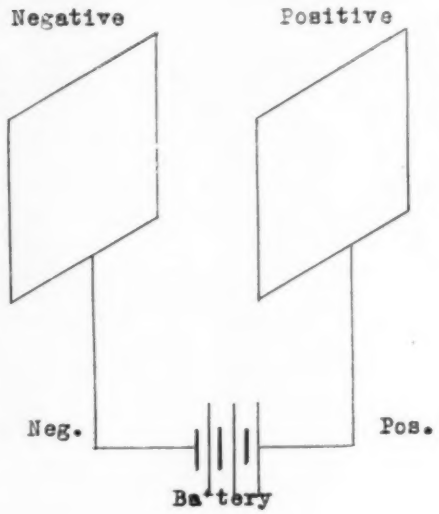


Figure. 40

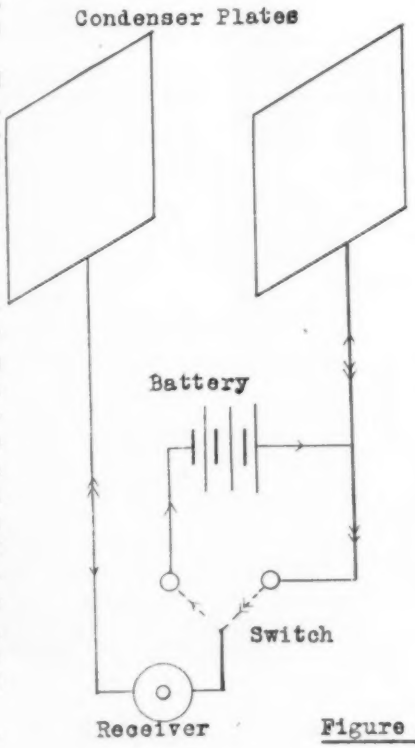


Figure 41

And there you will have a miniature flash of lightning.

Walking across a highly polished floor, and touching a radiator will produce the same result. Carrying your tool bag on a good frosty day and allowing the bag to rub back and forth along your overcoat will also set up a charge which will be felt as it jumps from your knuckles to the lock of the tool bag. There are many examples, as we will find as we discuss apparatus used to drain static charges away from our telephone lines. The reason we have mentioned static electricity at this point is to explain the use of a very common piece of apparatus used in telephone work, the condenser.

The Condenser

The boy standing on the board and insulators, was part of a condenser. The boy was one body charged, say, with positive static electricity. The other who wielded the fur was the negatively charged body. The motion of the arm in wielding the fur supplied the energy necessary to cause friction, and the friction was transferred into a charge of electrical energy. Here we find work transformed into electricity. The board on which the boy stood with the insulators is called the dielectric.

Now in place of the two boys and the board we will refer to Fig. 40.

Here we have two metal plates connected to the poles of a battery. Now if one pole of the battery is positive, and the other negative, then the wires connected to them will be of the same polarity. Therefore the plates connected to the wires will be of the same polarity as the battery. So we will then have one plate positive and the other negative. The air between the plates acts as an insulator, preventing the flow of current from the battery. Since one plate is positive and the other negative, there will be an attraction between the two plates. However, since it takes 10,000 volts to discharge across an inch of dry air, the attraction of one dry cell of 1½ volts will not get very far.

An experiment will explain very quickly what actually occurs. Get two pieces of copper or sheet iron about 6″x9″. The writer used two covers of 100 B. interrupters facing one another. Connect them to the 48 or 24-volt bat-

tery as shown in Fig. 41 so that the one connection from the receiver can be changed from (1) to (2) quickly. First lay one plate on the table and over it lay a sheet of writing paper. With the other plate connected as shown touch the receiver terminal from (1) to (2) in rotation, with the upper plate just covering the lower one about an inch. Observe that when you touch (1) there is a slight click, and then silence. Then touch (2) and there is another click and then silence. Repeat the experiment with the upper plate covering the lower one, at different positions, until they are exactly opposite. We will find that the greater the area of the two plates opposite each other, the louder the click, with just the one sheet of paper separating them.

Now repeat the experiment, but lay say 6 copies of Telephone Engineer over the lower plate and lay the upper plate directly over the lower one, with the magazines acting as a dielectric. Then repeat and remove one magazine for each test. Observe that the further the plates are apart the weaker the click, and the closer together, the loudest, with only one sheet of paper between the click is loudest of all. This experiment shows that there was a transfer of electric energy, as evidenced by the click in the receiver when the connection was made at (1) Fig. 41. We have shown this current flow by the single arrow. Then there was also a flow of current when connection was made at (2) Fig. 41 indicating that the condenser must have discharged. The ability of such a condenser to retain a charge is denoted by the word capacity. The quantity or degree of such capacity is shown by the word Farad. In telephone practice we do not use anything so large as a Farad, but all our condensers are in terms of Microfarads, or millionths of a Farad. The word Microfarad is abbreviated, and shown as M.F. Therefore, when we find on commercial condensers, 2 M.F. we understand that the capacity is 2 Microfarads, or 2 millionths of a Farad. In radiophone work we use smaller capacities still such as Micro, Microfarads, or the millionth of a millionth of a Farad.

Tone or Oscillator Set

To illustrate another characteristic of a condenser we will require a tone of high frequency, somewhere around 1000 cycles per second. There is usually an 800 cycle hummer or tone, in connection with toll line repeaters. If you have such an animal you might use it. For those not having one I will describe a dependable tone which will be found to be extremely useful around any telephone exchange. The circuit for this is shown in Fig. 42.

The material required for this is listed below:

1—U. V. or U. X. 199 tube, or a N. E. Co. Peanut tube.

1—Rheostat to suit the tube that is used. A Carter 30 ohm rheostat will possibly be the most compact.

1—Flashlight battery for filament of tube.

1—22-volt small size "B" battery.

Oscillator Circuit for Audible Frequencies.

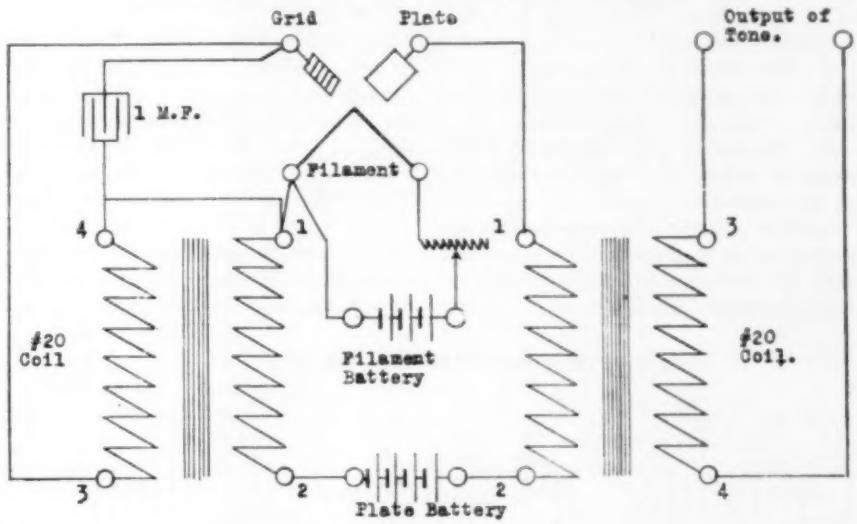


Figure 42

2—No. 20 induction coils, or any induction from a common battery telephone should do.

1—1 M.F. condenser.

The above apparatus can be assembled in a compact case. Should the apparatus not work, reverse the wires between the plate and the "B" battery. The capacity of the condenser may need to be altered, to suit the coils you are using.

With the oscillator described above as the source of high frequency, and the office generator as a low frequency, try experiments with different capacities with the two plates used in Fig. 41. Observe that the high frequency comes through

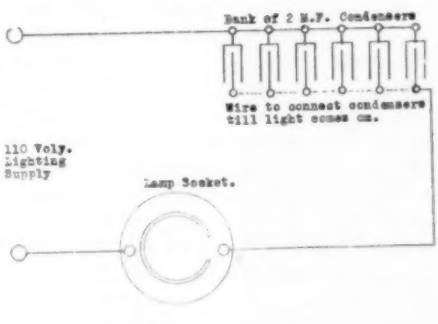


Figure 43

the receiver when the capacity is so small that the low frequency is scarcely heard. This is due to the fact that the higher the frequency, the less resistance offered by a condenser. Now whether the condenser plate is in the form of a sheet, or rolled in the form of a wire, it will possess capacity. As evidence of this connect the tone with the receiver in series to a dead pair in the office cable, or even a piece of jumper wire about 50 or 60 ft. long laid on the floor. There is a flow of current through the receiver as evidenced by the tone heard, when the wires are not connected at the distance end. So here we find that the two wires are really a condenser, and have capacity to hold an electrical charge.

If we were to connect direct current to the cable or the jumper wire in place of the alternating current, and used a voltmeter in place of the receiver, we would find that there would be a small deflection of the voltmeter when the connection was made, but the needle drops back again to zero, indicating that there is no flow of direct current.

One more experiment, to show that the larger the capacity of the condenser the lower the resistance. Connect a 100 watt lamp, or better, a 200 watt, in series with condensers and the 110 volt lighting current as shown in Fig. 43.

As the 2 M.F. condenser is possibly the most common size, suppose we take 6 2 M.F. condensers, connect one terminal of each condenser, and solder the wire in place. (When working with condensers, always solder the wires, even in experiments, if good results are to be expected.) Then connect the other side of the condensers, in, one at a time until the lamp lights. It will be found that the greater the capacity the nearer the lamp comes to full brilliancy. The construction of a condenser as used in telephone work can best be explained by tearing a bad one apart.

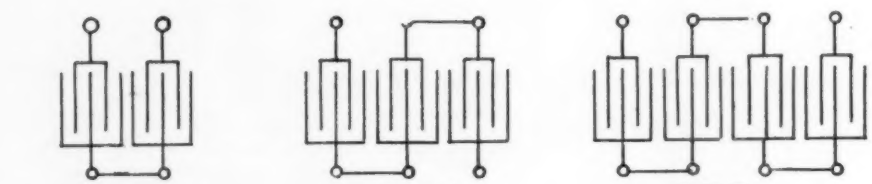
Connecting condensers in parallel, the capacities can be added together. Thus 2 2-M.F. in parallel gives 4 M.F. and 3 2-M.F. would be 6-M.F. Connecting the condensers in series divides the capacities. Thus 2 2-M.F. connected in series would be 1 M.F. while 4 2-M.F.

in series would give ½ M.F. This is illustrated in Fig. 44. The conventional method of marking condensers is used in this drawing.

The characteristics of condensers can be summed up as follows:

1. The two bodies are spoken of as the plates of the condenser.
2. The substance separating the plates is called the dielectric.
3. The greater the plate exposure, the greater the capacity.
4. The closer the plates are or the thinner the dielectric, the greater the capacity.
5. The higher the frequency of the charging current, the less the resistance of the condenser.
6. The greater the capacity of the condenser the lower the resistance.
7. Condensers will pass alternating current, but not direct.

Condensers connected in Series.



M.F. denotes Capacity in Micro Farads.

Figure 44

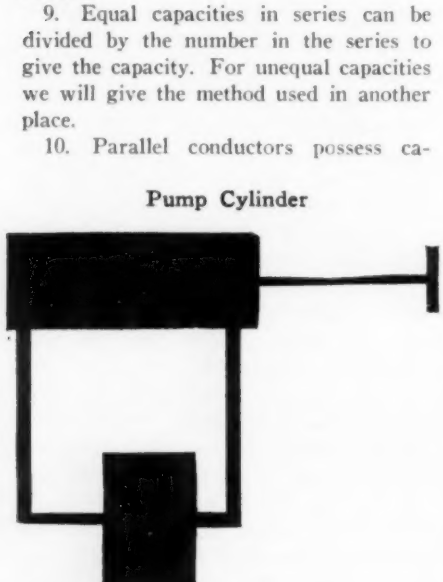
8. Equal capacities in multiple, can be added.
9. Equal capacities in series can be divided by the number in the series to give the capacity. For unequal capacities we will give the method used in another place.
10. Parallel conductors possess capacity, depending on the length, size, and the distance apart.

In practical use, a condenser will block the flow direct of current from the exchange, while the ringing current will operate the bell through the condenser.

In Fig. 45 is given an illustration of the effect produced by a condenser. At "A" is shown the cylinder of a pump. At "B" is shown a chamber separated by a rubber diaphragm. The two pipes connect the two sides of the pump with the two sides of the chamber. Pressure of the pump to the left will cause the water to be compressed in the left side of the chamber, and the rubber diaphragm will move to the right, forcing the water back into the right hand of the pump cylinder. Reversing the pump action reverses the action of the diaphragm. Now while the water in the left hand section never touches the water in the right hand section, the water in the right hand is forced to move. In the condenser, the battery or alternating current creates a pressure, on the one plate, which in turn creates a pressure on the other plate causing a change in the condition of the electrical circuit. Reversing the pressure causes a transfer of energy in the whole circuit.

(To Be Continued)

Pump Cylinder



Condenser Chamber with Rubber Diaphragm.

Figure 45

Oklahoma Telephone Company Expands

Hominy, Okla.—The Oklahoma Telephone Company has recently acquired the following exchanges: June 1, Osage Telephone Company, Osage, Okla., and on July 1, the Owasso Telephone Company, Owasso, Okla., and the Ramona Telephone Company, at Ramona, Okla.

This makes a total of nine exchanges now owned and operated by the Oklahoma Telephone Company in northeastern Oklahoma, located in the following towns and cities: Hominy, Fairfax, Barnsdall, Osage, Avant, Ramona, Owasso, Broken Arrow, and Stroud, Okla.

Mr. J. W. Walton is president, and in active charge of operations.

New York City—David F. Houston, financial vice-president of the American T. & T. Co. and president of the Bell Securities Co., has resigned to become president of the Mutual Life Insurance Co.

Atlanta, Ga.—J. C. Asher, formerly chief foreman of construction for the Southern Bell's Atlanta district, has joined the sales staff of the Everstick Anchor Co. of St. Louis, Mo.

Santa Monica, Cal.—Santa Monica Bay Telephone Co. is moving central office equipment into its new four story building from its old exchange headquarters.

Miller, Mo.—Rev. W. C. Hill, president of the Miller Telephone Co., died here recently as a result of injuries suffered in falling from a pole. His father founded the company at Miller.

OUR LITERARY DIGEST

Review of Recent Publications on the Telephone and Allied Subjects.

Safety Rules for the Installation and Maintenance of Electrical Supply and Communication Lines. Handbook of the Bureau of Standards No. 10.

This handbook comprises part 2 of the National Electrical Safety Code, fourth edition and is the result of the recent revision of this section. The revision has been made under the procedure of the American Engineering Standards Committee by a committee which includes representatives of the various classes of utilities concerned; representatives of State public utility commissions, of insurance interests, manufacturers, inspectors and other classes of persons concerned.

It is not possible in a brief review to indicate the extent to which the rules have been revised and expanded. A comparison between the rules as given in the third edition of the Safety Code with those given in the present revision will indicate the extensive development which has taken place within the comparatively few years since the last revision.

The latest edition is a notable improvement over the previous editions in the matter of arrangement of the material and in the typographical make-up of the sections. It would seem that the criticism which was made of previous editions that the rules were difficult to locate and interpret had largely been overcome.

The handbook may be secured from the Government Printing Office, Superintendent of Documents at a nominal price of 60 cents (money order, or bank draft but not stamps) and a copy should be in the files of every telephone company and other electric power using utility.

London, Eng.—Dr. Henry Wright, managing director of Siemens Bros. & Co., Ltd., and prominent in other English telephone and electric organizations, has been elected a director of the British Columbia T. & T. Co., a Gary organization.

Independents Set Annual Meet for October

Chicago, Ill.—Board of directors of the United States Independent Telephone Association have tentatively set the date for the next annual convention of the organization for October 18-21 at either Hotel Sherman or the new Hotel Stevens at Chicago. This action was taken at a conference of the directors and officials of the association held early in June at Chicago. Operating executives of class A companies also attended the directors' meeting.

A number of telephone companies were elected to membership in the association. W. L. Jacoby of the Kellogg Company was elected a director and a member of the executive committee of the association, succeeding J. B. Edwards, resigned.

Roy F. Wilder, general commercial manager of the Tri-State, was introduced as the newly elected head of the recently created commercial division of the association. Other sections having been solidly established and functioning in an active and practical way, the association is giving considerable attention to the commercial department. The present status of the depreciation order of the Interstate Commerce Commission was outlined by President MacKinnon at the convention.

C. B. Randall, vice-president of Tri-State Tel. & Tel. Co. and special counsel of the association on the depreciation order, explained the legal points in the order, after which H. F. Wheeler, chief engineer of the Lincoln Tel. & Tel. Co., Lincoln, Neb., presented an illustration of a method to be employed by the class C companies in spreading their plant accounts on their books in the 26 classes prescribed by the Interstate Commerce Commission and for arriving at the rate of depreciation to be set up for each such classes of property.

Friday was devoted to separate sessions of the accountants and engineers and the executives. W. L. Lemon, auditor of Lincoln Tel. & Tel. Co., Lincoln, Neb., and chairman of the association's accounting division, presided over the joint conferences of the accountants and engineers and President MacKinnon over the executives' conference.

At the joint conference of the accountants and engineers points in the order on depreciation of the Interstate Commerce Commission were considered. Presentation and discussion of the following subjects were made:

"Service Life Pricing on Reusable Material," by A. C. Cragg, St. Paul, Minn.

"Extraordinary Repairs," by Frank J. Brookman, Rochester, N. Y.

"Classes of Depreciable Property," by C. E. Archer, Tampa, Fla.

"Operating Expense Adjustments," by F. J. Tellman, Fort Wayne, Ind.

"Separation of Depreciation Reserve," by V. E. Chaney, Kansas City, Mo.

"Illustration of Telephone Companies' Application of the Interstate Commerce Commission's Order to Accounting Practice of Class C Companies," by H. F. Wheeler, Lincoln, Neb.

Anderson Elected Chief of Washington Association

Edmonds, Wash.—W. M. Anderson of Wenatchee was elected president of the Independent Telephone Association of Washington at its twelfth annual convention held here June 17 and 18. Other officers elected were:

Secretary- treasurer, J. P. Baker, Spokane.

Trustees: J. N. Faust, Ellensburg; D. S. Wilkinson, White Bluffs; James H. Milhollin, Blaine; D. M. Yost, Edmonds, and E. Smith, Chewelah.

The association picked North Bend as the 1928 convention meeting place. Sessions were well attended and the practical character of the program drew forth some lively discussions. Secretary-Treasurer J. W. Baker presented the annual report of association activities, which showed the organization to be moving ahead at a snappy gait.

Opening the convention were addresses by D. M. Yost of the Edmonds Telephone Co. on "Being a Host," and Chas. C. Deering, secretary-treasurer, United States Independent Telephone Association, Des Moines, Iowa, on "Independent Telephony."

During the afternoon the following addresses were made:

"Our Idea of Tariffs," by C. E. Krieger, department of public works.

"What to Do and How," by Claire Bowman, department of labor and industries.

"Engineering," by C. Maynard Turner, department of public works.

"Industrial Insurance," by John Shaughnessey, department of labor and industry.

"Safety Methods," by Martin J. Flyzik, department of labor and industry.

On the evening of June 17 the Rebekahs served dinner. Following the dinner the 32-piece band of employes of the Pacific Telephone & Telegraph Co. at Seattle played a number of selections and a splendid program of vocal and instrumental numbers was given by women employes of the Pacific Company from Seattle. To this was added a group of Scotch songs. A splendid first aid demonstration concluded the evening's program.

On Saturday morning these addresses were given:

"State Franchise," by Thomas McCrory, state highway department.

"Things to Be Done," by Hance Cleland, Olympia.

C. E. Hartigan of Spokane reported for the activities committee, recommending that the association materially enlarge its work and render greatly increased services to its members. The committee recommended the employment of Clifford & Cleland, attorneys of Olympia, to furnish advice and opinions to the association and to individual members; their services also to include preparation and distribution to members of a monthly bulletin.

The report was adopted and the secretary was instructed to ascertain how much of an assessment on a per station basis would be required to finance the movement.

On Saturday afternoon a number of the members drove to Everett to see the exchange of the Puget Sound Telephone Co. furnishing telechronometer metered service. Commercial Superintendent Allen entertained the visitors at lunch and showed them the plant.

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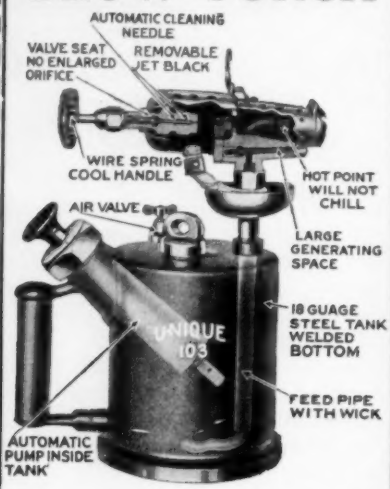

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Northern Hoosiers Talk It Over in Comfort

Wawasee Lake, Ind.—For the eighth time the Northern Indiana Telephone Association proved that a convention held in a more or less informal manner does a whole lot of practical good for the attendants. This year the Northern Indiana men met at Lake Wawasee on the veranda of South Shore Inn and listened to a number of talks of definite dollars and cents value. These addresses stirred up considerable discussion, with the result of bringing into the picture intimate details of the methods used by the able telephone men present. "Underground Construction" was the subject opened by Thad Hanway, Monticello, and as soon as this topic had been pretty well covered by the set address and discussions, Fred Pyle, pinch hitting for Roscoe Pontius, spoke on "Local and Toll Lines." "Problems of Our Business," the address delivered by Henry A. Barnhart, headlined a strong attack on the bond houses and other telephone men who were getting into the business without proper qualifications. Frank Bohn of Fort Wayne confirmed Mr. Barnhart's statements.

Sam Tomlinson, Plymouth, spoke on "The Executive," and Claude Stoops, Nappanee, on "Auditing and Bookkeeping," detailing many practical aspects of the telephone man's problems. The wind-up of the program was an address on commercial matters by A. D. Lewis of the Indiana Bell. During the meeting an operators' conference was held.

The special entertainment was staged by the salesmen present and they put on a show that added greatly to the delights of the meeting.

Who Has These Missing Copies for Sale?

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A "Beg Your Pardon" on Signal Corps Boards

In the June issue of TELEPHONE ENGINEER an article referring to U. S. Signal Corps orders for P. B. X. boards mentioned the adopting of two-position boards as regular equipment for army posts. This detail was in error, as two-position boards are not standard equipment at all posts obviously, and the statement slipped by without authority.

Glendale, Ind.—Pike County Telephone Co. has bought exchanges at Glendale and Alfordsville.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

of Telephone Engineer published monthly at Chicago, Ill., for May 1, 1927.

State of Illinois, County of Cook, ss.—Before me, a notary public in and for the state and county aforesaid, personally appeared W. H. Graffis, who, having been duly sworn according to law, deposes and says that he is the business manager of Telephone Engineer and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, general manager and business manager are:

Publisher — Wm. H. Graffis & Sons, 236 N. Clark St., Chicago, Ill.

Editor—Herbert Graffis, Chicago, Ill.

Business Manager—W. H. Graffis, Chicago, Ill.

Advertising Manager — Jos. M. Graffis, Chicago, Ill.

2. That the owners are (give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock):

W. H. Graffis, Herbert Graffis and Jos. M. Graffis, all of 236 N. Clark St., Chicago, Ill.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent of more of total amount of bonds, mortgages or other securities are (if there are none, so state) —None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder of security holder appears upon the books of the company as trustees or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any person, association or corporation has any interest, direct or indirect, in the said stock, bonds or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise to paid subscribers during the six months preceding the date above is..... (This information is required from daily publications only.)

TELEPHONE ENGINEER,
W. H. Graffis, Bus. Mgr.

Sworn to and subscribed before me this 31st day of March, 1927.
(Seal) ELEANOR DIENES.
(My commission expires March 24, 1929.)

American Electric Made West Mfg. Co. Outlet

Chicago, Ill.—American Electric Company, Inc., becomes the licensee and sole distributor of all products manufactured by West Manufacturing Company under an agreement recently made.

The West Manufacturing Company, organized its business in Abilene, Kansas, several years ago for the purpose of Manufacturing what was then known as the "Anderson Trouble Finder." In 1926 the company was moved to Chicago and established its main office at 447 Monadnock Block, and the "Anderson Trouble Finder" was then renamed the "West Test Set."

This West instrument is a combined test set and portable telephone. It is a simple, compact device for locating line troubles, such as shorts, grounds, opens, crosses, etc., with the use of a finder coil. Its generator supplies the test tone without the use of vibrators, buzzers or batteries. The outstanding feature of this test set the company states, is the ease and speed with which a lineman alone can locate troubles without opening circuits and without aid from the main office.

The West Test Set is being widely adopted by many telephone companies, railroads, oil companies and electric power companies throughout the world.

While the West Manufacturing Company remains actively in business, American Electric Company, Inc., now becomes licensee and distributor of the West Test Set and other products which the West Company is developing.

Welker Is Expert Fisher for Directories

Canton, O.—Getting telephone directories "out of the red" is the job that J. H. Welker of Canton has laid out for himself and his proficiency in the job has been demonstrated to a large number of telephone companies that have availed themselves of his services. Mr. Welker believes that telephone directory advertising pays both the advertiser and the telephone company. Being thoroughly sold on the proposition himself, he has developed some unique selling methods during his experience of over twenty years in this field. The basis of his success is a personal service both to the advertiser and to the telephone company. For the advertiser, he has a wealth of suggestions as to effective presentation of his story and not infrequently is the advertising copy prepared and ready for the printer at the time the advertiser puts his name on the dotted line. Much improvement in the form and appearance of telephone directories in the cities where he has worked is due to his suggestion. Of course, Welker has a hobby outside of his work also. We are told that the bass and trout in the streams and lakes in a certain section of northern Michigan go back into their deepest hiding places during the part of the summer that he spends there. And even then they are not safe for the man who is so adept in landing an advertising prospect is equally expert in his dealings with the finny tribe.

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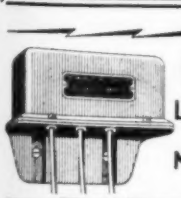

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Stromberg or Garford 800 ohm line peanut relays @	.60
Kellogg No. 118 C. B. desk set with No. 140 steel signal set equipped with No. 79 Booster Ckt. Ind. Coil and Straight line or 16-33-50 or 66 Cycle harmonic ringers @	7.25
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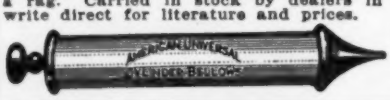

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